



**SWEET
SWEEP**

SOIL AND WATER
ENVIRONMENTAL
ENHANCEMENT PROGRAM



**PAMPA
PAMPA**

PROGRAMME D'AMELIORATION
DU MILIEU PEDOLOGIQUE
ET AQUATIQUE



SWEEP

is a \$30 million federal-provincial agreement, announced May 8, 1986, designed to improve soil and water quality in southwestern Ontario over the next five years.

PURPOSES

There are two interrelated purposes to the program; first, to reduce phosphorus loadings in the Lake Erie basin from cropland run-off; and second, to improve the productivity of southwestern Ontario agriculture by reducing or arresting soil erosion that contributes to water pollution.

BACKGROUND

The Canada-U.S. Great Lakes Water Quality Agreement called for phosphorus reductions in the Lake Erie basin of 2000 tonnes per year. SWEEP is part of the Canadian agreement, calling for reductions of 300 tonnes per year — 200 from croplands and 100 from industrial and municipal sources.



PAMPA

est une entente fédérale-provinciale de 30 millions de dollars, annoncée le 8 mai 1986, et destinée à améliorer la qualité du sol et de l'eau dans le Sud-ouest de l'Ontario.

SES BUTS

Les deux buts de PAMPA sont: en premier lieu de réduire de 200 tonnes par an d'ici 1990 le déversement dans le lac Erie de phosphore provenant des terres agricoles, et de maintenir ou d'accroître la productivité agricole du Sud-ouest de l'Ontario, en réduisant ou en empêchant l'érosion et la dégradation du sol.

SES GRANDES LIGNES

L'entente entre le Canada et les États-Unis sur la qualité de l'eau des Grands Lacs prévoyait de réduire de 2 000 tonnes par an la pollution due au phosphore dans le bassin du lac Erie. PAMPA fait partie de cette entente qui réduira cette pollution de 300 tonnes par an — 200 tonnes provenant des terres agricoles et 100 tonnes provenant de sources industrielles et municipales.

VOLUME V

**ECONOMIC ASSESSMENT OF THE
TECHNOLOGY EVALUATION AND
DEVELOPMENT (TED) PROGRAM**

Prepared for:

**Agriculture Canada
for the
Soil and Water Environmental
Enhancement Program**

By:

**Deloitte & Touche Management Consultants
Guelph, Ontario
October 1992**

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
1.0 INTRODUCTION	1
1.1 OBJECTIVES	1
1.2 SCOPE	1
1.3 ORGANIZATION OF REPORT	1
2.0 MANAGEMENT OF FARM FIELD VARIABILITY ...	5
2.1 ECONOMIC OBJECTIVES AND METHODS	5
2.3 RESULTS AND CONCLUSIONS	7
3.0 DEVELOPMENT AND TESTING OF A DRY FERTILIZER PLACEMENT MACHINE	12
3.1 ANALYSIS	13
3.2 CONCLUSIONS	21
4.0 MANURE MANAGEMENT FOR CONSERVATION FARMING FOR POLLUTION CONTROL	22
4.1 EXPERIMENT #3 - FINDINGS	23
4.2 EXPERIMENT #4 - FINDINGS	26
5.0 EVALUATION OF AERATION TILLAGE SYSTEMS	29
5.1 OBJECTIVES	29
5.2 ANALYSIS	29

Table of Contents Continued

6.0	THE FEASIBILITY OF BAND SPRAY APPLICATION IN CONJUNCTION WITH INTER- ROW CULTIVATION IN NO-TILL CORN	31
6.1	OBJECTIVES	31
6.2	ANALYSIS	31
6.3	CONCLUSIONS	35
APPENDIX A	Farm Field Variability Supporting Graphs & Tables	
APPENDIX B	Evaluation of Aeration Tillage Systems Summary of Problems	

LIST OF TABLES

Table 1.1	TED Projects	3
Table 2.1	Percent of Crop Land Below Breakeven Yield Using T-2000 Prices	8
Table 2.2	Percent of Crop Land Below Breakeven Yield Using Decade High Prices	9
Table 2.3	Percent of Crop Land Below Breakeven Yield Using Decade Low Prices	10
Table 3.1	Development and Testing of a Dry Fertilizer Placement Machine - Physical Inputs (1989)	16
Table 3.2	Development and Testing of a Dry Fertilizer Placement Machine - Financial Analysis (1989)	16
Table 3.3	Development and Testing of a Dry Fertilizer Placement Machine - Physical Inputs (1990) - Albin Site	17
Table 3.4	Development and Testing of a Dry Fertilizer Placement Machine - Financial Analysis (1990) - Albin Site	18
Table 3.5	Development and Testing of a Dry Fertilizer Placement Machine - Physical Inputs (1990) - Prong Site	19
Table 3.6	Development and Testing of a Dry Fertilizer Placement Machine - Financial Analysis (1990) - Prong Site	20
Table 4.1	Partial Budget for Manure Management in Conservation Farming, Experiment #3	24
Table 4.2	Partial Budget for Manure Management in Conservation Farming, Experiment #4	27
Table 6.1	No-till corn yields as affected by cultivation alone, cultivation plus high rate or low rate, broadcast or banded herbicides in 1990 and 1991.	32
Table 6.2	Partial Budget for Band Spray Application with Inter-Row Cultivation in No-till Corn	34

EXECUTIVE SUMMARY

This report contains the technical background data and economic analysis of selected projects conducted under the Technology Evaluation and Development (TED) sub-program of the Soil and Water Environmental Enhancement Program (SWEEP).

The TED subprogram is comprised of a wide variety of projects with the intent of developing and testing alternative conservation technologies. The majority of the TED projects were technical experiments or demonstrations for which little or no relevant economic data was collected nor was it appropriate to do so. Of the eight projects for which economic data was collected, data limitations prevented any economic analysis for three of the projects. Data for the remaining five projects permitted varying degrees of economic analysis, primarily in the form of partial budget analysis.

As a general observation, the economic data reviewed and analyzed varied greatly in terms of both completeness and accuracy. Moreover, the inherent experimental design imposed limitations on the degree of analysis which could be undertaken in some cases. Where this occurred, it is noted in the individual case studies.

The key findings of the various projects analyzed in this study are:

- Yield variability within fields results in a varying proportion of the field which does not cover production costs. This proportion is dependent on crop price.
 - An experimental dry fertilizer placement machine compares favourably to conventional technology given similar capital and operating costs.
 - Liquid manure would be an economically valid substitute for ammonium nitrate if the cost of treatment was comparable.
-

- A banded pre-emergent herbicide treatment in conjunction with one or two cultivations is the most economical weed control system for corn.

This report elaborates on the consequences of these and other findings.

1.0 INTRODUCTION

This report provides an economic assessment of selected projects conducted under the Technology Evaluation and Development (TED) Sub-program of SWEEP. The primary purpose of the TED sub-program is to develop and test a range of soil and water conserving technologies for use in Ontario.

1.1 OBJECTIVES

The objective of this exercise was to assess the impact of selected soil conservation technologies on farm level economies.

1.2 SCOPE

The TED research projects which have been undertaken, whether or not economic data is available, and the limitations on that data are presented in Table 1.1. With one exception, the TED projects upon which economic analysis was performed, consisted of plot to field scale experiments comparing differing input and management regimes designed to minimize soil loss and/or degradation. The general format for the economic analysis consists of partial budgets which compare the marginal costs (or savings) of different treatments with the consequent increase or decrease in revenue, as indicated by change in crop yield in most cases.

Partial budgets are used because the level of data required to support whole crop analysis was not collected. In cases where data was not collected, but is essential to understanding the relative benefits of alternative technologies, we have attempted to infer impacts based upon industry standards. Specific instances where data has been inferred are highlighted.

1.3 ORGANIZATION OF REPORT

This report represents Volume V of a seven volume series, consisting of:

Volume I:	An Economic Evaluation of Soil Tillage Technologies: Summary Report
Volume II:	Collection and Analysis of Field Data From PDW
Volume III:	Field Level Economic Analysis of Changing Tillage Practices in Southwestern Ontario
Volume IV:	An Economic Evaluation of the Tillage 2000 Program in Ontario
Volume V:	An Economic Assessment of the Technology Evaluation and Development (TED) Program
Volume VI:	Watershed Level Economic Analysis of Tillage Practices in Southwestern Ontario
Volume VII:	Macro-Economic Impact Assessment of Soil Conserving Technologies

This report outlines the objectives of five TED projects, the status of the analysis, the type of analysis performed including limitations of the data, and the results of economic analysis. The five projects examined are:

- Management of Farm Field Variability;
- Development and Testing of a Dry Fertilizer Placement Machine;
- Manure Management for Conservation Farming for Pollution Control;
- Evaluation of Aeration Tillage Systems; and
- The Feasibility of Band Spray Application in Conjunction with Inter-Row Cultivation in No-Till Corn

Table 1.1 TED Projects

COMPLETED PROJECTS	ECONOMIC DATA	DATA LIMITATIONS
A Review of Farm Based Soil Conservation Research and Development	No	N/A
Structural Degradation - Pilot Study	No	N/A
Cover Crop Management - Oxford, Waterloo, Wellington	No	N/A
The Effect of Terraces on Phosphorus Movement	No	N/A
Modifications to the Mouldboard Plow	No	N/A
Effect of Management on Surface Hydraulic Properties	No	N/A
Monitoring and Evaluating the Effects of Subsoiling	No	N/A
Machinery Modifications and Practical Tips	No	N/A
Demonstration Trials of Cover Crop Species and Varieties - Oxford, Waterloo, Wellington	No	N/A
Effect of Management on Surface Hydraulic Properties (Part 2)	No	N/A
The Impact of the Use of Anhydrous Ammonia on Soil and Water Quality	No	N/A
Nutrient Distribution and Stratification Resulting from Conservation Farming	No	N/A
Control of Problem Weed Species	No	N/A
Survey of Moisture Distribution Between Tile Drainage Laterals and its Relationship to Compaction and Rooting Depth in Flat Clay Soils	No	N/A
Cover Crop Management - Huron and Middlesex	No	N/A
Study on the Interaction of Corn Hybrids with Two Levels of Tillage and Study on the Effect of Split Applications of Nitrogen on Corn Yield	No	N/A
Effects of Phosphorus Sources in Various Farming Systems	No	N/A
No-Till Drilling of Soybeans	No	N/A
Low Temperature Tolerance of Grain Corn Under No-Till Conditions	No	N/A
Comparison of Planters and Fertilizer Application Systems for No-Till Corn	No	N/A

Table 1.1 TED Projects Continued

ONGOING PROJECTS	ECONOMIC DATA	DATA LIMITATIONS
MANAGEMENT OF FARM FIELD VARIABILITY	YES	N/A
Optimal Herbicide Use in Conservation Tillage Systems	No	N/A
The Effect of Organic Mulches on Soil Moisture and Crop Growth	No	N/A
THE DEVELOPMENT AND TESTING OF A DRY FERTILIZER PLACEMENT MACHINE	YES	II
MANURE MANAGEMENT FOR CONSERVATION FARMING	YES	II
THE USE OF COVER CROPS FOR NUTRIENT CONSERVATION	YES	Y
THE USE OF KELP AND MOLASSES IN AERATION TILLAGE SYSTEMS	YES	A
Red Clover Management	No	N/A
Soil and Crop Response to Fall Subsoiling	No	N/A
P Movement in Soil as a Function of P Solubility and Reactivity	No	N/A
Field Scale Tests of the Modified Mouldboard Plow	No	N/A
Preparation of New Planting Equipment for Testing on Commercial Farms Under No-Till Conditions	No	N/A
Effects of Tillage on the Quality of Surface Runoff and Subsurface Drainage Water; Uplands	No	N/A
Loss of Nitrogen by Microbial Denitrification and Nitrification; Relation to Tillage Methods	No	N/A
Effects of Tillage on the Quality of Surface and Subsurface Water; Lowlands	No	N/A
Field Testing of Cover Crop Systems for Corn and Soybean Production	No	N/A
Emergence and Stress Adaption to Water and Soil Temp. Conditions in a Non-Tilled Sandy Loam	No	N/A
Development of a Computer-Based Farm Decision Support Framework	No	N/A
Response of Soil Microflora and Fauna to Spring Plowing of Zero-Till and Pasture Soils	No	N/A
Field Scale Tests of Spring Cereal Cover Crops and Hairy Vetch	No	N/A
FEASIBILITY OF BAND SPRAY APPLICATION IN CONJUNCTION WITH INTER-ROW CULTIVATION IN NO-TILL CORN	YES	N/A
Evaluation of Row Crop Planter Modifications for Corn Production within Conservation Tillage Systems	No	N/A
LAND RESHAPING ON LOWLAND SOILS	YES	U
EVALUATION OF AERATION TILLAGE SYSTEMS	YES	II
Soil Loss by Tillage Erosion	No	N/A
Management of Mulch Tillage Systems on Clay Soils	No	N/A
Study of Yield Reduction Effects of Crop Residue in Conservation Tillage	No	N/A

Limitations Codes for Table 1.2:

Y = all yield data missing
II = some input data missing

A = data not yet available

U = extraneous factors involved - plots not necessarily comparable

2.0 MANAGEMENT OF FARM FIELD VARIABILITY

The primary objectives of this TED project were twofold:

- To examine the influence of landform, soil, tillage practices, and resulting soil loss on crop yield; and
- To assess yield variability within fields from year to year.

This project involved collecting soil characteristic and yield data for paired tillage treatments (conventional vs. conservation) from eight to twelve small sub-plots located at various slope locations within randomly selected fields in southwestern Ontario. The within-field variations in relative yield differences (averaged over all five growing seasons) were provided for the paired tillage treatments. In other words, the difference between the mean yield for the entire field and the lowest and highest yield observations within a field, as well as individual standard deviations, were provided for paired conventional and conservation tillage plots. The average difference between the highest and lowest yielding areas in a field for all years and observations was 40% of the mean yield. The within-field variability in yield was not significantly different between the two tillage systems. Specifically, the use of conservation tillage practices do not reduce apparent yield variability within fields.

2.1 ECONOMIC OBJECTIVES AND METHODS

The objectives of the economic analysis were two-fold:

- To compare net returns by tillage method for the low, average, and high yielding areas of fields; and
- To calculate the yield which generates a financial breakeven point for each field and estimate the area of each field that falls below the

breakeven level.

To satisfy the first economic objective, individual producer costs and average yields were obtained from the T-2000 report (Volume IV) for the different tillage practices (conventional, minimum, and no-till). Average yields for each producer were then adjusted by the low and high relative yield differences to determine the revenue per acre for the three yield scenarios. Profit margins were derived by subtracting variable and total costs from each of the three (low, average, and high) yield revenue values. Finally, net returns were plotted, including average net returns, to facilitate a comparison between the three tillage methods under each of the low, average, and high yield scenarios.

The second economic objective involved financial breakeven analysis. Both total cost and total variable cost were divided by crop price to determine the respective breakeven yields. Assuming that yield variability was normally distributed, it was then possible to determine the proportion of each field that fell below the breakeven yield. An example will be used to demonstrate this methodology.

One producer had an average corn yield of 109.3 bu/ac under conventional tillage in 1989. Given his cost structure, the breakeven yield to cover total costs in that year was 76.7 bu/ac. In order to calculate what percentage of his field produced below this level, it is necessary to calculate a *z-score*, as follows:

$$z = \frac{X - \mu}{\sigma} = \frac{76.7 - 109.3}{19.6} = -1.66$$

where X = the breakeven yield,
 μ = the mean yield, and
 σ = the standard deviation.

This means that the breakeven yield, 76.7 bu/ac, is 1.66 standard deviations below the mean, 109.3 bu/ac, of the standard Normal distribution. The area

to the left of 1.66 standard deviations below the mean of the standard Normal distribution corresponds to the field area below the breakeven yield level if the field exhibits a normal yield distribution. This area can be read directly from a standard Normal distribution table. For this example, the area to the left of 1.66 standard deviations from the mean is 4.85%. In other words, 4.85% of this producer's field produced a corn yield below the breakeven level in 1989 (assuming a normal distribution of yields).

Three crop prices were used for this simulation exercise:

- 1) prices used in the T-2000 analysis (Volume IV),
- 2) decade high prices as reported by OMAF Publication 20 (Table 2.2), and
- 3) decade low prices as reported by OMAF Publications 20 (Table 2.3).

2.3 RESULTS AND CONCLUSIONS

The breakeven analysis for winter wheat, soybeans and corn is presented in Tables 2.1, 2.2, and 2.3 according to three crop prices. Based on an examination of average percentages of land below breakeven yields, it appears that conservation tillage on wheat is most beneficial, (e.g. comparing 9.7 - 7.1% TVC to 13.7% TVC - Table 2.2). However, the opposite occurs for soybeans. Unfortunately, insufficient data exists to assess whether these differences are statistically valid.

Fortunately, sufficient data for corn was available to assess the statistical significance between tillage systems. Results of our analysis indicate that there is no significant difference in the percent of land area within fields below breakeven yields, between conventional, minimum, and no-tillage systems.

By simulating the analysis with different crop prices, these conclusions do not change. The detailed analysis supporting Tables 2.1 - 2.3 are provided in Appendix A.

Table 2.1 Percent of Crop Land Below Breakeven Yield Using T-2000 Prices

PERCENT OF WINTER WHEAT LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	31.6%	74.2%	3.0%	29.5%		
B	9.3%	95.3%			4.1%	38.6%
D			22.4%	45.2%	16.9%	40.5%
Average	20.5%	84.7%	12.7%	37.3%	10.5%	39.6%

PERCENT OF SOYBEAN LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	6.9%	24.8%			10.9%	36.3%
B	0.2%	4.3%	0.1%	0.2%		
C	3.7%	25.5%			2.0%	16.6%
D			17.9%	30.5%	0.1%	1.4%
E			12.5%	30.5%	15.9%	37.8%
Average	3.6%	18.2%	10.2%	20.4%	7.2%	23.0%

PERCENT OF CORN LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	0.1%	3.6%	0.0%	0.3%		
B	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
D	0.0%	0.9%			0.0%	0.0%
E	0.0%	0.0%	0.0%	0.0%		
F	0.1%	4.9%			0.0%	0.0%
G	0.0%	0.0%	0.0%	0.0%		
H	0.0%	0.0%	0.0%	0.0%		
I	0.0%	0.0%	0.0%	0.0%		
J	0.0%	0.1%	0.0%	0.0%		
K	0.0%	0.0%			0.0%	0.0%
L	0.0%	0.0%			0.0%	0.0%
M	0.0%	0.2%	0.0%	0.4%		
N			0.2%	23.9%	0.1%	18.4%
O			0.1%	4.2%	0.0%	2.1%
P			0.0%	0.9%	0.0%	0.1%
Q			0.0%	0.0%	0.0%	0.0%
R			0.0%	0.5%	0.0%	0.0%
S			9.7%	23.6%	2.2%	9.3%
Average	0.0%	0.7%	0.7%	3.6%	0.2%	2.5%

Table 2.2 Percent of Crop Land Below Breakeven Yield Using Decade High Prices

**PERCENT OF WINTER WHEAT LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))**

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	23.8%	58.3%	1.3%	13.4%		
B	3.8%	75.2%			1.5%	16.4%
D			18.1%	34.8%	12.7%	29.1%
Average	13.7%	66.7%	9.7%	24.1%	7.1%	22.7%

**PERCENT OF SOYBEAN LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))**

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	5.5%	15.9%			8.9%	24.8%
B	0.1%	0.8%	0.0%	0.1%		
C	1.3%	8.4%			0.6%	4.6%
D			14.0%	22.1%	0.1%	0.4%
E			10.0%	21.2%	12.5%	26.4%
Average	2.3%	8.4%	8.0%	14.4%	5.5%	14.0%

**PERCENT OF CORN LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))**

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	0.0%	0.5%	0.0%	0.0%		
B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
D	0.0%	0.0%			0.0%	0.0%
E	0.0%	0.0%	0.0%	0.0%		
F	0.0%	0.8%			0.0%	0.0%
G	0.0%	0.0%	0.0%	0.0%		
H	0.0%	0.0%	0.0%	0.0%		
I	0.0%	0.0%	0.0%	0.0%		
J	0.0%	0.0%	0.0%	0.0%		
K	0.0%	0.0%			0.0%	0.0%
L	0.0%	0.0%			0.0%	0.0%
M	0.0%	0.0%	0.0%	0.0%		
N			0.0%	5.9%	0.0%	3.0%
O			0.0%	0.6%	0.0%	0.2%
P			0.0%	0.0%	0.0%	0.0%
Q			0.0%	0.0%	0.0%	0.0%
R			0.0%	0.0%	0.0%	0.0%
S			4.7%	11.3%	0.7%	2.7%
Average	0.0%	0.1%	0.3%	1.2%	0.1%	0.5%

Table 2.3 Percent of Crop Land Below Breakeven Yield Using Decade Low Prices

**PERCENT OF WINTER WHEAT LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))**

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	45.6%	90.7%	8.4%	62.9%		
B	26.1%	99.9%			14.0%	77.0%
D			30.2%	61.4%	24.8%	59.1%
Average	35.9%	95.3%	19.3%	62.2%	19.4%	68.1%

**PERCENT OF SOYBEAN LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))**

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	7.9%	30.5%			12.3%	43.3%
B	0.4%	8.9%	0.1%	0.4%		
C	6.1%	39.0%			3.5%	27.8%
D			20.1%	35.6%	0.1%	2.7%
E			14.0%	35.9%	18.1%	44.0%
Average	4.8%	26.1%	11.4%	24.0%	8.5%	29.4%

**PERCENT OF CORN LAND BELOW BREAKEVEN YIELD
(For Total Variable Cost (TVC) and Total Cost (TC))**

Producer	Conventional		Minimum		No-till	
	TVC	TC	TVC	TC	TVC	TC
A	0.7%	48.8%	0.0%	33.4%		
B	0.0%	20.1%	0.0%	8.2%	0.0%	0.0%
C	0.0%	18.9%	0.0%	8.7%	0.0%	0.0%
D	0.0%	87.3%			0.0%	0.4%
E	0.0%	0.0%	0.0%	0.9%		
F	1.1%	50.0%			0.0%	0.6%
G	0.0%	0.0%	0.0%	1.9%		
H	0.0%	3.8%	0.0%	87.3%		
I	0.0%	0.0%	0.0%	0.0%		
J	0.0%	19.2%	0.0%	0.0%		
K	0.0%	0.0%			0.0%	0.0%
L	0.0%	0.0%			0.0%	0.0%
M	0.0%	23.3%	0.0%	19.7%		
N			2.0%	87.7%	1.0%	89.6%
O			0.3%	50.4%	0.1%	50.4%
P			0.0%	74.9%	0.0%	17.1%
Q			0.0%	0.0%	0.0%	0.1%
R			0.0%	59.1%	0.0%	1.7%
S			32.3%	64.1%	15.9%	49.2%
Average	0.1%	20.9%	2.3%	33.1%	1.4%	17.4%

In all tillage systems, a portion of the fields examined did not reach breakeven yields, and in some cases, variable costs were not covered. However, the proportion of the field which does not cover the costs of production is directly proportional to the crop price.

The question which remains unanswered is whether different tillage systems might have an impact on farm field variability over a multi-year time frame. That is, will the application of soil conserving technology over time reduce the inherent variability within the field through reduction in erosion?

3.0 DEVELOPMENT AND TESTING OF A DRY FERTILIZER PLACEMENT MACHINE

The objective of this TED project was to develop a machine which would provide farmers practising conservation tillage with the means to apply dry form nitrogen sources (i.e. urea and/or ammonium nitrate). Before the project began, the standard nitrogen source used in reduced tillage systems was liquid 28% N which was applied by an applicator developed to inject the material into the soil.

There are several potential benefits to the use of a machine (hereafter referred to as the fertilizer zone-tiller) similar to the prototype tested:

- The environmental risks associated with fertilizer storage and handling are lower with dry forms (urea and ammonium nitrate) than with liquid 28% and anhydrous ammonia;
- The fertilizer zone tiller can be pulled in tandem with the planter thus reducing field passes and hence, reduce compaction and fuel consumption.

The specific objectives of the TED project, as stated in the study terms of reference, were:

- To develop an effective dry fertilizer placement machine for use in conservation tillage programs, and
- To accommodate the use of nitrogen in urea form as an effective, economic and safe form of nitrogen in reduced tillage situations.

The criteria for judging the success of this project (as stated in the Final report to SWEEP) were established as follows:

If corn fertilized using the fertilizer zone-tiller performed (in terms of yield, biomass, height and nitrogen uptake) at least as well as corn fertilized with the liquid 28% N applicator, **then**, the fertilizer zone-tiller is a feasible fertilizer placement machine.

Objective of the Economic Analysis

The objective of this economic analysis was to evaluate the potential economic returns to using the fertilizer zone-tiller. The criteria for evaluating the success of the project as stated above refer only to technical parameters. In economic terms, the machine could still be considered a success even if lower yields are observed, if the machine contributed to lowered costs of production sufficient to compensate for the lower yields. Similarly, the machine would not be an economic success if the costs of using the technology outweighed the benefits of increased yields associated with the technology.

3.1 ANALYSIS

This analysis includes partial budgets which examine the net returns over variable costs only. Because the dry fertilizer placement machine is a prototype, no capital value is available. Similarly, it is very difficult to predict the useful life of such a piece of equipment, hence, calculating equipment costs (depreciation) is difficult.

It should be noted that comparisons between the dry fertilizer placement machine, and 28% liquid involve a comparison between systems, not simply a replacement of one type of machine for another. Nitrogen costs on an actual basis differ between urea and 28%, and weed control programs are also different, involving different herbicides applied at different times (this data is unclear, and has not been included in the analysis). Therefore, the difference in net returns to each system can not be attributed to the type of machine

alone, but should be considered in light of the entire system, any part of which may have influenced the outcome.

Two years of data were analyzed (1989 and 1990). Treatments were differentiated by type of application, type of fertilizer, rate of actual nitrogen applied, and timing of application. The treatments were as follows:

1989 Treatments:

- 1a Urea, Zone tillage application, 56 kg actual N/Ha, applied at planting
- 1b Urea, Zone tillage application, 56 kg actual N/Ha, applied at 6 leaf stage
- 2a Urea, Zone tillage application, 156 kg actual N/Ha, applied at planting
- 2b Urea, Zone tillage application, 156 kg actual N/Ha, applied at 6 leaf stage
- 3a 28%, sidedress application, 56 kg actual N/Ha, applied at planting
- 3b 28%, sidedress application, 56 kg actual N/Ha, applied at 6 leaf stage
- 4a 28%, sidedress application, 156 kg actual N/Ha, applied at planting
- 4b 28%, sidedress application, 156 kg actual N/Ha, applied at 6 leaf stage

1990 Treatments:

Treatments for the 1990 crop year were duplicated at two sites. The treatments used at each site were as follows:

- 1a Urea, Zone tillage & planter applied, 50 kg actual N/Ha, applied at planting*
- 1b Urea, Zone tillage & planter applied, 50 kg actual N/Ha, applied at 6 leaf stage*
- 2a Urea, Zone tillage & planter applied, 150 kg actual N/Ha, applied at planting*
- 2b Urea, Zone tillage & planter applied, 150 kg actual N/Ha, applied at 6 leaf stage*

-
- 3a 28%, Injected, 50 kg actual N/Ha, applied at planting
 - 3b 28%, Injected, 50 kg actual N/Ha, applied at 6 leaf stage
 - 4a 28%, Injected, 150 kg actual N/Ha, applied at planting
 - 4b 28%, Injected, 150 kg actual N/Ha, applied at 6 leaf stage
 - 5a 28%, Slot planting, 50 kg actual N/Ha, applied at planting
 - 5b 28%, Slot planting, 50 kg actual N/Ha, applied at 6 leaf stage
 - 6a 28%, Slot planting, 150 kg actual N/Ha, applied at planting
 - 6b 28%, Slot planting, 150 kg actual N/Ha, applied at 6 leaf stage

*Note: 20% of Nitrogen was applied through planter as ammonium nitrate

The physical and financial data for crop year 1989 are shown in Tables 3.1, and 3.2 respectively, and the physical and financial data for crop year 1990 are shown in Tables 3.3, and 3.4 respectively for the Albin site, and Tables 3.5 and 3.6 for the Prong site.

Table 3.1 Development and Testing of a Dry Fertilizer Placement Machine - Physical Inputs (1989)

	Plot 1a (Zone-till)	Plot 1b (Zone-till)	Plot 2a (Zone-till)	Plot 2b (Zone-till)	Plot 3a	Plot 3b	Plot 4a	Plot 4b
Seed rate	27,000	27,000	27,000	27,000	27,500	27,500	27,500	27,500
Actual N (kg/ha)	56 Urea	56 @ 6 leaf Urea	156 Urea	156 @ 6 leaf Urea	56 28%	56 @ 6 leaf 28%	156 28%	156 @ 6 leaf 28%
Yield (kg/ha)	5295	5388	5911	5553	5680	5159	6338	5922

Note: Plots designated (a) N applied at seeding, Plots designated (b) N applied at 6 leaf stage

Table 3.2 Development and Testing of a Dry Fertilizer Placement Machine - Financial Analysis (1989)

	Plot 1a	Plot 1b	Plot 2a	Plot 2b	Plot 3a	Plot 3b	Plot 4a	Plot 4b
Seed Cost	75.95	75.95	75.95	75.95	77.35	77.35	77.35	77.35
"N" Cost	35.00	35.00	97.50	97.50	39.76	39.76	110.76	110.76
Input Cost	110.95	110.95	173.45	173.45	117.11	117.11	188.11	188.11
Gross Rev.	469.03	477.27	523.60	491.88	503.13	456.98	561.42	524.56
Net Revenue	358.08	366.32	350.15	318.43	386.02	339.87	373.31	336.45

Note: Seed Cost based on \$90.00/unit (80,000 seeds)
Fertilizer cost: Urea = \$.625/kg actual, 28% = \$.71/kg actual, Corn \$3.25/bu = \$88.58/tonne

Table 3.3 Development and Testing of a Dry Fertilizer Placement Machine - Physical Inputs (1990) - Albin Site

	Plot 1a (Zone-till)	Plot 1b (Zone-till)	Plot 2a (Zone-till)	Plot 2b (Zone-till)	Plot 3a	Plot 3b	Plot 4a	Plot 4b
Actual N (kg/ha)	50 Urea	50 @ 6 leaf Urea	150 Urea	150 @ 6 leaf Urea	50 28%	50 @ 6 leaf 28%	150 28%	150 @ 6 leaf 28%
Yield (kg/ha)	5265	6912	7497	7202	4404	3470	5931	6280

	Plot 5a (slot-plant)	Plot 5b (slot-plant)	Plot 6a (slot-plant)	Plot 6b (slot-plant)
Actual N (kg/ha)	50 Urea	50 @ 6 leaf Urea	150 Urea	150 @ 6 leaf Urea
Yield (kg/ha)	4774	4048	6912	6179

Note: Plots designated (a) N applied at seeding. Plots designated (b) N applied at 6 leaf stage
All zone till plots: 20% of actual N applied as NH_4NO_3

Table 3.4 Development and Testing of a Dry Fertilizer Placement Machine - Financial Analysis (1990) - Albin Site

	Plot 1a	Plot 1b	Plot 2a	Plot 2b	Plot 3a	Plot 3b	Plot 4a	Plot 4b
N Cost	31.63	31.63	94.88	94.88	35.50	35.50	106.50	106.50
Gross Rev.	466.37	612.26	664.08	637.95	390.11	307.37	525.37	556.28
Net Revenue	434.74	580.63	569.20	543.07	354.61	271.87	418.87	449.78

	Plot 5a	Plot 5b	Plot 6a	Plot 6b
N Cost	35.50	35.50	106.50	106.50
Gross Rev.	422.08	358.57	612.26	547.33
Net Revenue	387.38	323.07	505.76	440.83

Note: Fertilizer cost: Urea = \$.625/kg actual, 28% = \$.71/kg actual, NH_4NO_3 = \$.70/kg actual, Corn \$3.25/bu = \$88.58/tonne

Table 3.5 Development and Testing of a Dry Fertilizer Placement Machine - Physical Inputs (1990) - Prong
Site

	Plot 1a (Zone-till)	Plot 1b (Zone till)	Plot 2a (Zone-till)	Plot 2b (Zone-till)	Plot 3a	Plot 3b	Plot 4a	Plot 4b
Actual N (kg/ha)	50 Urea	50 @ 6 leaf Urea	150 Urea	150 @ 6 leaf Urea	50 28%	50 @ 6 leaf 28%	150 28%	150 @ 6 leaf 28%
Yield (kg/ha)	8748	7188	8143	8055	7471	7861	7793	7975

	Plot 5a (slot-plant)	Plot 5b (slot-plant)	Plot 6a (slot-plant)	Plot 6b (slot-plant)
Actual N (kg/ha)	50 Urea	50 @ 6 leaf Urea	150 Urea	150 @ 6 leaf Urea
Yield (kg/ha)	6986	7356	7255	7074

Note: Plots designated (a) N applied at seeding, Plots designated (b) N applied at 6 leaf stage
 All zone till plots: 20% of actual N applied as NH_4NO_3

Table 3.6 Development and Testing of a Dry Fertilizer Placement Machine - Financial Analysis (1990) - Prong Site

	Plot 1a	Plot 1b	Plot 2a	Plot 2b	Plot 3a	Plot 3b	Plot 4a	Plot 4b
"N" Cost	31.63	31.63	94.88	94.88	35.50	35.50	106.50	106.50
Gross Rev.	774.90	636.71	721.31	711.74	661.78	696.33	690.30	706.42
Net Revenue	743.27	605.08	626.43	616.86	626.28	660.83	583.80	599.93

	Plot 5a	Plot 5b	Plot 6a	Plot 6b
"N" Cost	35.50	35.50	106.50	106.50
Gross Rev.	618.82	651.60	642.65	626.61
Net Revenue	583.32	616.10	536.15	520.11

Note: Fertilizer cost: Urea = \$.625/kg actual, 28% = \$.71/kg actual, NH_4NO_3 = \$.70/kg actual, Corn \$3.25/bu = \$88.58/tonne

3.2 CONCLUSIONS

This analysis shows that, for crop year 1989, returns to using urea fertilizer placed using the experimental machine were slightly lower than conventionally applied 28%. Average returns over seed and fertilizer costs were \$348.25 for dry fertilizer treatments and \$358.91 for liquid fertilizer. However, it should be noted that these results are based on only 3 replications, and are probably not statistically significant. It appears that timing of nitrogen application is somewhat less critical using the dry fertilizer.

In the 1990 crop year the dry fertilizer application appears to have delivered higher average returns (calculated as total revenue minus fertilizer cost) than did the liquid nitrogen application. Average net returns were as follows:

Dry fertilizer (urea and ammonium nitrate):	\$624.86
Liquid 28% nitrogen injected:	\$495.75
Liquid 28% nitrogen and slot planting:	\$489.09

It is unclear however, whether the increase in yield and net revenues on the dry fertilizer plots should be attributed to the use of dry fertilizer in general, or whether the use of ammonium nitrate fertilizer banded with the planter had any effect on the outcome of the experiment.

Based on this analysis, it would seem that the capital and operating costs for the experimental machine would have to be similar to conventional liquid nitrogen technology for it to be attractive to producers in the short run, given the current price relationship for nitrogen between urea and 28% forms.

4.0 MANURE MANAGEMENT FOR CONSERVATION FARMING FOR POLLUTION CONTROL

Manure management is an important component of conservation farming. Manure application to farmland is a potential source of pollution to both surface and groundwater. At the same time, many conservation systems emphasize the use of manure as fertilizer material as a method of slowing nutrient release, and contributing valuable organic matter. Manure management presents some practical obstacles in terms of use as an crop input. Manure, as a by-product of the livestock enterprise, is as often treated as a disposal problem as a crop input.

This TED project examined several potential management systems for optimizing manure application for crop nutrition. The research consisted of four experiments with the following specific objectives:

- Experiment 1:** To determine the effect of oilseed radish, manure application, and tillage on nutrient and corn performance (following winter wheat).
- Experiment 2:** To determine the appropriate timing and effectiveness of manure and a rye cover crop to supply nutrients to no-till soybeans, minimizing rye regrowth and optimizing soil cover for erosion control.
- Experiment 3:** To determine the effect of manure form and rate on winter wheat in spring, surface applied conservation tillage systems.
- Experiment 4:** To determine the effects of the application of solid manure at different rates, and in different forms, on weeds and species composition in established forages.

Objectives of the Economic Analysis

Our objective was to assess the economic significance of the above TED experiments. Economic analysis was completed for experiments #3 and #4 only, in the form of partial budgets. The budgets developed consider only the differences between treatments. Data for experiment #1 and experiment #2 do not support economic analysis for the following reasons:

- Experiment #1 involved an examination of the biomass development of oilseed radish at two different sites under equivalent manure applications. A control (i.e. oilseed radish without manure application) was not provided. Since it is difficult to place an economic value on the oilseed radish at this time, no economic analysis was attempted.
- Experiment #2 involved an examination of the soil coverage achieved under different treatments. As in experiment #1, no baseline data exist which hindered our ability to infer a specific economic benefit directly from levels of soil residue cover.

4.1 EXPERIMENT #3 - FINDINGS

This experiment examined the wheat and clover yield response under seven fertility treatment regimes (including the control). Three different fertilizer materials were used including composted beef manure, ammonium nitrate and liquid hog manure, each was applied at two different rates.

Partial budgets for each treatment are shown in Table 4.1. Explanatory notes for this table are as follows:

- Wheat yields are given on both an "establishment method" (EM) basis and a "fertilizer types and rates" (FTR) basis. No information is given on the relationship (if any) between the two, consequently separate results are presented in Table 4.1 for each yield source.

Table 4.1 Partial Budget for Manure Management in Conservation Farming, Experiment #3

Winter Wheat	Fertilizer Type & Rates (FTR)							Establishment Method (EM)	
	Control	Compost @ 7.5 t/ha	Compost @ 15 t/ha	Ammon N ¹ @ 50 kg N/ha	Ammon N ¹ @ 100 kg N/ha	Manure @ 40,000 L/ha	Manure @ 80,000 L/ha	Conven.	No-Till Aerial
Cost of Operations (\$/ha): (T-2000) ¹ Apply Fertilizer ²	0.00	17.02	34.04	12.90	12.90	88.00	176.00	132.92	122.92 40.56
Material Costs: Wheat - Seed rate (kg/ha) - Seed cost (\$/ha)									
Fertilizer	0.00	0.00	0.00	11.75	23.50	0.00	0.00		
Total Cost (\$/ha)	\$0.00	\$17.02	\$34.04	\$24.65	\$36.40	\$88.00	\$176.00	\$167.72	\$157.72 \$92.76
Outputs: Yield - wheat (t/ha) - clover (kg/ha) (biomass)	1.96 2416	2.13 2316	2.29 2196	3.86 511	3.71 294	3.92 799	3.74 418	3.1	3.02 3.11
Crop price (\$/t) ³	115.00	115.00	115.00	115.00	115.00	115.00	115.00	115.00	115.00 115.00
Revenue (\$/ha) Wheat Clover ⁴	\$225.40 ? ?	\$244.95 ? ?	\$263.35 ? ?	\$443.90 ? ?	\$426.65 ? ?	\$450.80 ? ?	\$430.10 ? ?	\$356.50	\$347.30 \$357.65
Margin (\$/ha): Revenue - MC Revenue - TC	\$225.40 \$225.40	\$244.95 \$227.93	\$263.35 \$229.31	\$432.15 \$419.25	\$403.15 \$390.25	\$450.80 \$362.80	\$430.10 \$254.10	\$321.70 \$188.76	\$312.50 \$189.58 \$305.45 \$264.89

¹ Cost of operations are from T-2000; cost per hectare for winter wheat (minus the Ontario average custom cost of applying fertilizer to avoid double counting.) Cost of aerial seed application is from communication with seed applicators.

² Apply Fertilizer rates for fertilizer are from OMAF, Report No: 92-06; for liquid manure is \$0.01/gal.

³ Crop price is from OMAF, Ag Stats for Ontario, 1990.

⁴ The "?" serves as a reminder that although no value has been included for clover residue, it should be incorporated in the analysis.

- "Cost of Operations" for the EM basis are derived from the T-2000 study: cost per hectare for winter wheat (Volume IV). For the FTR basis, costs were not entered since it could not be determined if there was any difference between the plots; hence operations were assumed to be the same for all plots.
- "Apply Fertilizer" costs under the FTR basis for compost are calculated from unpublished survey data collected for the OMAF Survey of Custom farm rates; costs for dry fertilizer are average Ontario custom rates from OMAF, Report No: 92-06; for liquid manure the cost was assumed to be \$0.01/gal. Since no data was provided on the EM basis, no costs were entered.
- The "Seed Rate" (and hence cost) for wheat was assumed to be the same for all plots under the FTR basis.
- "Fertilizer" cost under the FTR basis is zero for compost and manure since it was assumed that this is a disposal cost for the livestock enterprise (the application cost was assigned to the cropping enterprise). Once again, the data for the EM basis was not provided so cost of fertilizer was omitted.
- "Total Cost" refers to total incremental costs. In other words, only those costs that differ between the alternative plots were recorded in order to directly compare the net costs and benefits of the alternative applications.
- As mentioned above, wheat yields were provided on two different bases, FTR (fertilizer type and rate) and EM (establishment method). Experimental data for clover yields were only provided for the FTR basis.
- Crop price was obtained from OMAF, Agricultural Statistics for Ontario, 1990.

- Revenue for wheat is simply crop yield times price. No revenue for clover is credited although the nutrient value of the residue represents a savings for the next crop year's inputs.
- Aerial seeding costs are based on estimated costs provided by Crop Protection Services Ltd.

Total revenue minus material costs (MC) is similar for both ammonium nitrate and liquid manure treatments, and substantially above both the control and compost treatments. Revenue minus total costs is greatest for the ammonium nitrate treatment due to substantially lower costs of application for fertilizer as opposed to manure. However, given the comparable yield results, liquid manure would be an economically valid substitute for ammonium nitrate if the cost of the manure treatment was comparable to ammonium nitrate.

In addition, it should be noted that the failure to include a value for the clover plowdown tends to discriminate against the compost and control treatments, where clover biomass for these treatments was substantially above the biomass produced on either the manure or the fertilized treatment.

4.2 EXPERIMENT #4 - FINDINGS

Experiment #4 examined forage crop yields under various manure management regimes and included a total of six treatments utilizing a control treatment, two manure treatments and two compost treatments at different application rates, and one chemical fertilizer treatment.

Findings for this experiment are shown in Table 4.2. The assumptions used in developing this table are as follows:

Table 4.2 Partial Budget for Manure Management in Conservation Farming, Experiment #4

Hay	Control	Manure @ 10 t/ha	Manure @ 20 t/ha	Compost @ 7.5 t/ha	Compost @ 15 t/ha
<u>Cost of Operations (\$/ha):</u>					
Apply Fertilizer ¹	0.00	22.70	45.40	17.02	34.04
<u>Material Costs (\$/ha):</u>					
Fertilizer	0.00	0.00	0.00	0.00	0.00
<u>Total Cost (\$/ha)</u>	\$0.00	\$22.70	\$45.40	\$17.02	\$34.04
<u>Outputs:</u>					
Yield (kg/ha)					
- 2nd cut hay	2844	3049	2642	3006	2854
- alfalfa	2260	2418	1976	2387	2138
- timothy	558	605	591	587	629
- weeds	26	26	75	32	87
Crop price (\$/t) ²	66.40	66.40	66.40	66.40	66.40
<u>Revenue (\$/ha)</u>	\$188.84	\$202.45	\$175.43	\$199.60	\$189.51
<u>Margin (\$/ha):</u>					
Revenue - MC	\$188.84	\$202.45	\$175.43	\$199.60	\$189.51
Revenue - TC	\$188.84	\$179.75	\$130.03	\$182.58	\$155.47

¹ *Apply Fertilizer* rates for fertilizer are from OMAF, Report No: 92-06 and communication with Financial Analysis Services, OMAF.

² Crop price is from OMAF, Ag Stats for Ontario, 1990.

- Cost of applying solid manure is estimated using unpublished data collected by OMAF for The Survey of Custom Farmwork Rates Charged in Ontario. The cost of applying fertilizer is obtained from OMAF, Report No: 92-06.
- As above, the material costs for compost and manure are assumed to be zero for the cropping enterprise. The fertilizer rate and cost was not given.
- "Total Cost" is defined as above.
- Yields were provided in the Experiment data.
- Crop price is obtained from OMAF, Agricultural Statistics for Ontario, Publication 20, 1990.

It appears that higher rates of manure or compost may have a detrimental effect on hay yields. This may occur because of mechanical damage and compaction caused by more trips over the land with a manure spreader, or may be related to the impact of a more dense manure layer on the crop. When the yield depression is added to the increased cost per hectare of heavier applications, the net returns to high applications drop substantially relative to the lighter applications. As in Experiment #3, the highest yields were recorded on the chemical fertilizer treatments.

5.0 EVALUATION OF AERATION TILLAGE SYSTEMS

5.1 OBJECTIVES

The objective of this project was to evaluate the Ontario Biological and Aeration Tillage Association (OBATA) approach to reducing cultivation, chemical inputs, soil erosion, and the potential for non-point pollution. The OBATA approach incorporates a number of factors including use of the AER-WAY tillage system, kelp and/or molasses foliar sprays, and cover crops between seasons.

5.2 ANALYSIS

The analysis presented in this document is limited to a discussion of the limitations of the existing data set. While some actual analysis of the within year impacts of foliar applied sprays and Aer-way tillage compared to conventional practices could be undertaken, the results of such an analysis would be of dubious value given the confusion which exists over what actually took place on most of the treatments.

While the project was intended to demonstrate the technical feasibility of establishing cover crops as well, no economic analysis is possible on this topic as plot sizes changed on a yearly basis, and continuity appears to have been lost. In addition, evaluation of the economics of specific treatments is not always possible due to a lack of, or conflicting information regarding what inputs were used.

A detailed summary of the problems and inconsistencies encountered in the data set are presented in Appendix B for the individual co-operators. Some of the common problems across all experiments include:

- Progression from year to year was not well documented and plot sizes were inconsistent. This made it difficult or impossible to incorporate the

operations after harvest into the analysis for next year. A thorough, and more accurate, analysis would require incorporating these operations into the current year's framework.

- Not only plot size, but plot location changed from year to year which increased our inability to include operations from the previous fall, following harvest, in any financial analysis.
- There was an abundance of incomplete or missing data, and often when data were provided, there were conflicting sources of information.

6.0 THE FEASIBILITY OF BAND SPRAY APPLICATION IN CONJUNCTION WITH INTER-ROW CULTIVATION IN NO-TILL CORN

This study was undertaken to determine whether the use of aggressive heavy duty cultivators have a beneficial effect on reduced-tillage corn production; and also whether the use of such cultivation in conjunction with banded herbicide application can compare favourably with or surpass the level of weed control currently being obtained with control strategy that relies almost entirely on herbicides.

6.1 OBJECTIVES

The goal of this study was to develop an integrated weed management program for use in reduced-tillage corn production utilizing band herbicide application in conjunction with inter-row cultivation. The study also proposed to evaluate the efficacy of specific pre-emergent and post-emergent herbicide treatments in this system and to test the practicality and usefulness of this system by using field-scale equipment and large research plots.

6.2 ANALYSIS

Economic analysis in the form of partial budgets was conducted on Experiment I of this study - "Integrated Weed Control in Reduced-Tillage Corn" - which was designed to assess the benefits of the use of a heavy duty cultivator on reduced-tillage corn production as well as the use of cultivation in conjunction with banded herbicide application. The budgets developed consider only the differences between treatments and are based on the cultivation, herbicide, and yield information provided in Table 6.1. All other operations and inputs are stated (or assumed) to be the same across all plots.

Table 6.1 No-till corn yields as affected by cultivation alone, cultivation plus high rate or low rate, broadcast or banded herbicides in 1990 and 1991.

Treatment	Rate kg ai/ha	Applied	Yield T/ha		Avg. Yld T/ha
			1990	1991	
WEEDED CHECK PLOTS					
1. Check, 0 cult. weeded			7.76	5.41	6.58
2. Check, 1 cult. weeded			7.35	5.41	6.38
3. Check, 2 cult. weeded			8.87	5.35	7.11
NON-WEEDED CHECK PLOTS					
4. Check, 0 cult. weedy			6.52	4.63	5.57
5. Check, 1 cult. weedy			8.37	5.61	6.99
6. Check, 2 cult. weedy			7.96	5.32	6.64
BROADCAST PRE-EMERGENT					
7. Metolachlor + Cyanazine 0	2.64 + 2.25	pre ^{1/}	7.99	5.21	6.60
8. Metolachlor + Cyanazine 1	2.64 + 2.25	pre ^{1/}	8.91	5.43	7.17
9. Metolachlor + Cyanazine 2	2.64 + 2.25	pre ^{1/}	9.13	5.69	7.41
10. Metolachlor + Cyanazine 0	1.68 + 1.75	pre ^{1/}	8.35	5.15	6.75
11. Metolachlor + Cyanazine 1	1.68 + 1.75	pre ^{1/}	7.70	5.86	6.78
12. Metolachlor + Cyanazine 2	1.68 + 1.75	pre ^{1/}	8.21	5.52	6.86
13. Cyanazine 0	1.75	pre ^{1/}	7.69	5.31	6.50
14. Cyanazine 1	1.75	pre ^{1/}	9.15	4.89	7.02
15. Cyanazine 2	1.75	pre ^{1/}	8.68	6.61	7.64
BANDED PRE-EMERGENT					
16. Metolachlor + Cyanazine 0	2.64 + 2.25	pre ^{2/}	6.58	4.68	6.63
17. Metolachlor + Cyanazine 1	2.64 + 2.25	pre ^{2/}	9.16	5.29	7.22
18. Metolachlor + Cyanazine 2	2.64 + 2.25	pre ^{2/}	9.25	6.30	7.77
19. Metolachlor + Cyanazine 0	1.68 + 1.75	pre ^{2/}	8.25	4.53	6.39
20. Metolachlor + Cyanazine 1	1.68 + 1.75	pre ^{2/}	8.98	5.19	7.08
21. Metolachlor + Cyanazine 2	1.68 + 1.75	pre ^{2/}	8.58	5.80	7.19
22. Cyanazine 0	1.75	pre ^{2/}	9.54	4.48	7.01
23. Cyanazine 1	1.75	pre ^{2/}	9.31	5.20	7.25
24. Cyanazine 2	1.75	pre ^{2/}	9.48	5.16	7.32

0 = 0 cultivation, 1 = 1 cultivation, 2 = 2 cultivations

^{1/} pre broadcast

^{2/} pre banded

Table 6.1 displays the individual and average yields for 1990 and 1991 for the 24 different treatments. The first six treatments are "check" plots, meaning they did not receive any herbicide applications. The first three check plots were hand weeded along with 0, 1, or 2 cultivations while the last three check plots only received the cultivation treatments. Treatments 7-15 consisted of various *broadcast* pre-emergent herbicide treatments along with 0, 1, or 2 cultivations whereas the last nine treatments consisted of *banded* pre-emergent herbicide along with cultivation.

Results from the partial budget analysis are presented in Table 6.2. The cost of the cultivation and spraying operations was obtained from averages of OMAF, Report No: 92-06. Material (herbicide) costs were derived by multiplying the rate of actual ingredient per hectare by the cost per unit of actual ingredient. Herbicide costs for the banded treatments are calculated as 40 percent of the broadcast cost since only 40% of the area is treated with a band sprayer. Total cost should be interpreted as the incremental increase in cost per hectare from the check plots receiving no cultivations. Revenue was calculated using the average yields from Table 6.1 and 1990-91 average corn prices from OMAF, Agricultural Statistics for Ontario, Publication 20, 1990.

The high and low yield and margin values are highlighted in Table 6.2. While the lowest yield was associated with treatment 4 (the unweeded plot receiving zero cultivations), the lowest margin is associated with treatment 7 (the high rate herbicide application with zero cultivations), which has a higher cost structure. The difference between the margins of these two treatments is probably not statistically significant. The highest yield and margin observations are associated with treatment 18 (the high herbicide rate with two cultivations), which also has the highest cost structure of the banded treatments.

Table 6.2 Partial Budget for Band Spray Application with Inter-Row Cultivation in No-till Corn

TREATMENT	COST					REVENUE			MARGIN
	Operations		Materials		Total	Ave.	Ave.	Total	TR-TC
	Cult.	Spray	Metol.	Cyan.	Cost	Yield	Price	Revenue	
	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	t/ha	\$/t	\$/ha	\$/ha
WEEDED CHECK PLOTS									
1. Check, 0 cult. weeded	0	0	0	0	0	6.58	103	678	\$678
2. Check, 1 cult. weeded	15.61	0	0	0	16	6.38	103	657	\$642
3. Check, 2 cult. weeded	31.22	0	0	0	31	7.11	103	732	\$701
NON-WEEDED CHECK PLOTS									
4. Check, 0 cult. weedy	0	0	0	0	0	5.57	103	574	\$574
5. Check, 1 cult. weedy	15.61	0	0	0	16	6.99	103	720	\$704
6. Check, 2 cult. weedy	31.22	0	0	0	31	6.64	103	684	\$653
BROADCAST PREEMERGENT									
7. Metolachlor + Cyanazine 0	0	15.51	55.19	40.25	111	6.60	103	680	\$569
8. Metolachlor + Cyanazine 1	15.61	15.51	55.19	40.25	127	7.17	103	739	\$612
9. Metolachlor + Cyanazine 2	31.22	15.51	55.19	40.25	142	7.41	103	763	\$621
10. Metolachlor + Cyanazine 0	0	15.51	35.12	31.30	82	6.75	103	695	\$613
11. Metolachlor + Cyanazine 1	15.61	15.51	35.12	31.30	98	6.78	103	698	\$601
12. Metolachlor + Cyanazine 2	31.22	15.51	35.12	31.30	113	6.86	103	707	\$593
13. Cyanazine 0	0	15.51	0	31.30	47	6.50	103	670	\$623
14. Cyanazine 1	15.61	15.51	0	31.30	62	7.02	103	723	\$661
15. Cyanazine 2	31.22	15.51	0	31.30	78	7.64	103	787	\$709
BANDED PREEMERGENT									
16. Metolachlor + Cyanazine 0	0.00	15.51	22.07	16.10	54	6.63	103	683	\$629
17. Metolachlor + Cyanazine 1	15.61	15.51	22.07	16.10	69	7.22	103	744	\$674
18. Metolachlor + Cyanazine 2	31.22	15.51	22.07	16.10	85	7.77	103	800	\$715
19. Metolachlor + Cyanazine 0	0.00	15.51	14.05	12.52	42	6.39	103	658	\$616
20. Metolachlor + Cyanazine 1	15.61	15.51	14.05	12.52	58	7.08	103	729	\$672
21. Metolachlor + Cyanazine 2	31.22	15.51	14.05	12.52	73	7.19	103	741	\$667
22. Cyanazine 0	0.00	15.51	0.00	12.52	28	7.01	103	722	\$694
23. Cyanazine 1	15.61	15.51	0.00	12.52	44	7.25	103	747	\$703
24. Cyanazine 2	31.22	15.51	0.00	12.52	59	7.32	103	754	\$695

Average margins for each group of treatments are as follows:

- Weeded Check Plots \$673/ha
- Non-Weeded Check Plots \$644/ha
- Broadcast Pre-emergent \$622/ha
- Banded Pre-emergent \$674/ha

It should be noted that although the first three treatments (the weeded check plots) were hand weeded, no cost was associated with this treatment, so the high margins presented for this group should be interpreted accordingly. While the hand weeded check plots are expected to achieve the highest margin given a low cost structure and virtually no weed competition, the banded pre-emergent treatments as a group had the highest average margin. Singling out the Cyanazine treatments alone (treatments 13-15 and 22-24) results in an average for broadcast pre-emergent and banded pre-emergent treatments of \$664/ha and \$697/ha respectively.

Average margins by number of cultivations are:

- Zero Cultivations \$624/ha
- One Cultivation \$659/ha
- Two Cultivations \$669/ha

Although costs are lower under zero cultivations, the gain in corn yield associated with one or two cultivations more than compensates for the additional cost of the cultivation(s).

6.3 CONCLUSIONS

In general, it appears that a banded pre-emergent herbicide treatment in conjunction with one or two cultivations is the most economical weed control system of the treatments analyzed in this study. More specifically, a banded

treatment of a low rate of Cyanazine alone with any number of cultivations seemed to provide the highest overall net return of any subgroup in the analysis.

The lowest returns, on the other hand, were generally associated with the broadcast pre-emergent treatments as a group or with those treatments receiving no cultivations.

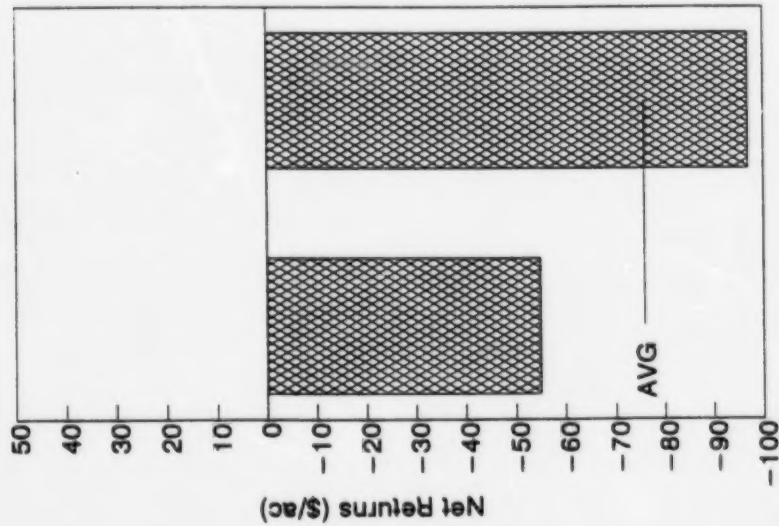
APPENDIX A

**Farm Field Variability
Supporting Graphs & Tables**



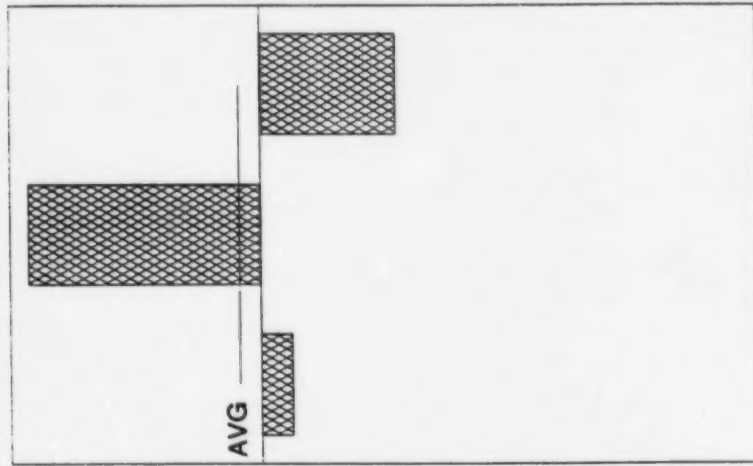
Winter Wheat
Low, Average, and High Returns

WINTER WHEAT
Low Returns



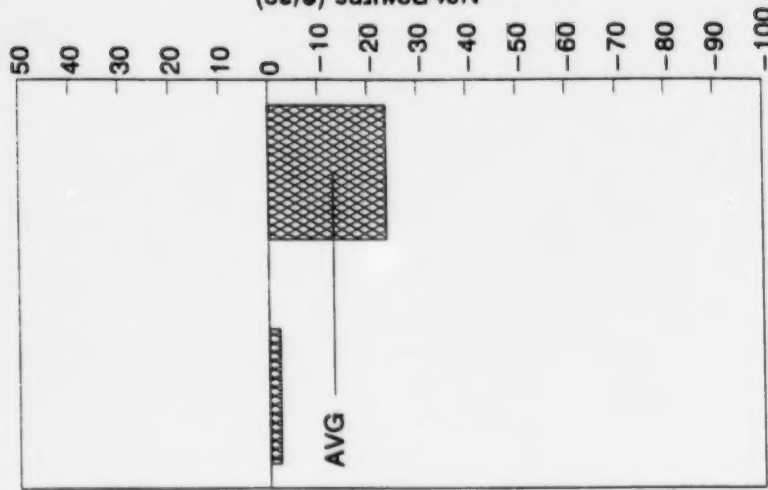
Conventional Tillage

WINTER WHEAT
Low Returns



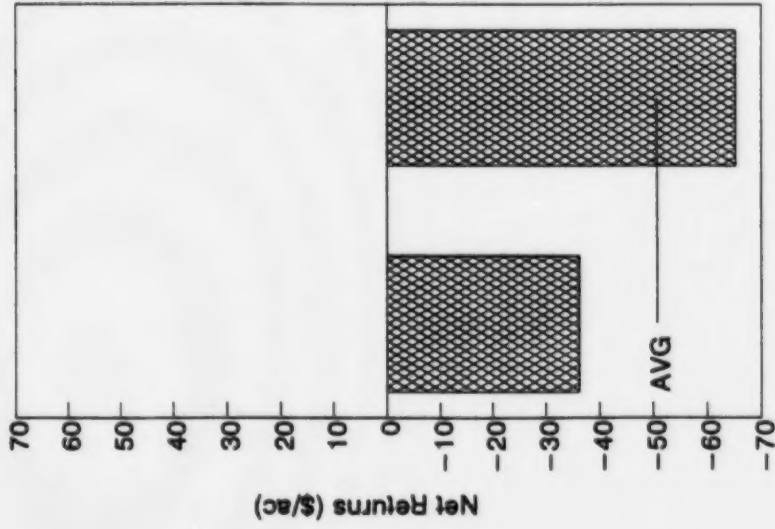
Minimum Tillage

WINTER WHEAT
Low Returns



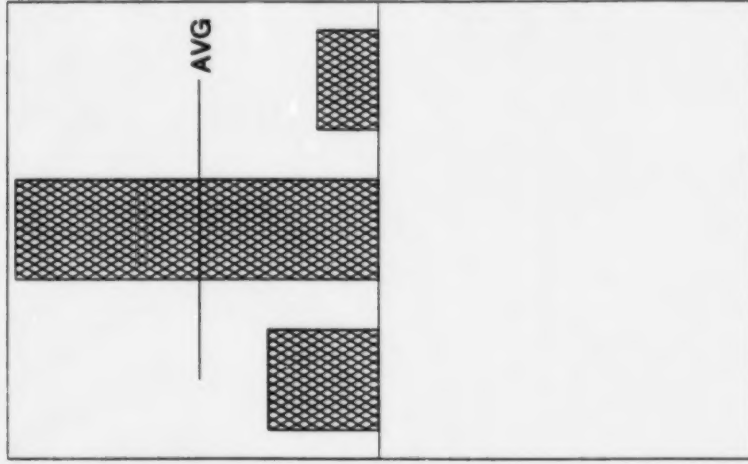
No Tillage

WINTER WHEAT
Average Returns



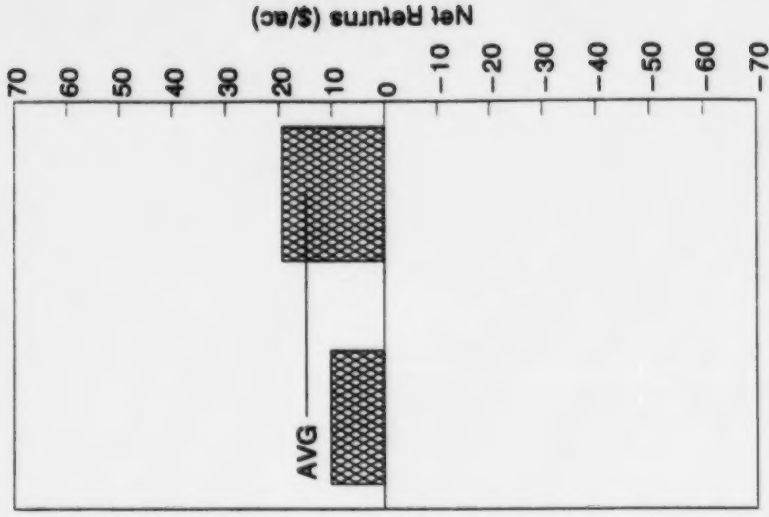
Conventional Tillage

WINTER WHEAT
Average Returns



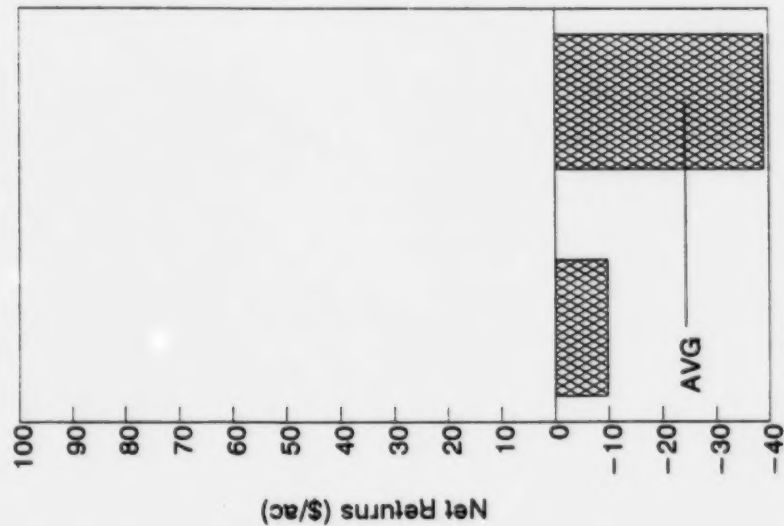
Minimum Tillage

WINTER WHEAT
Average Returns



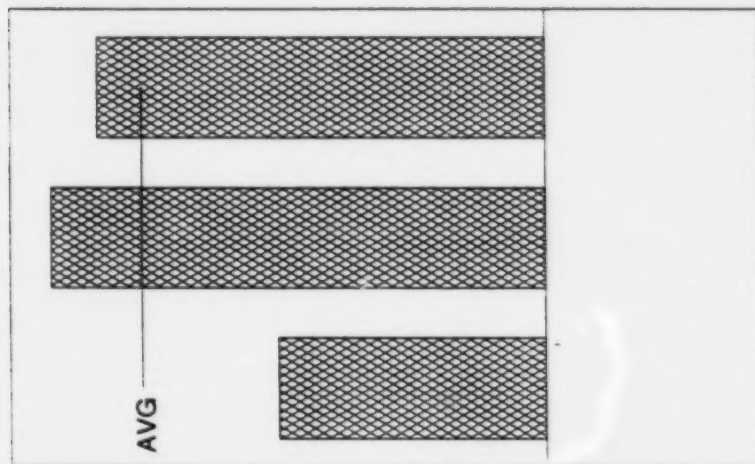
No Tillage

WINTER WHEAT
High Returns



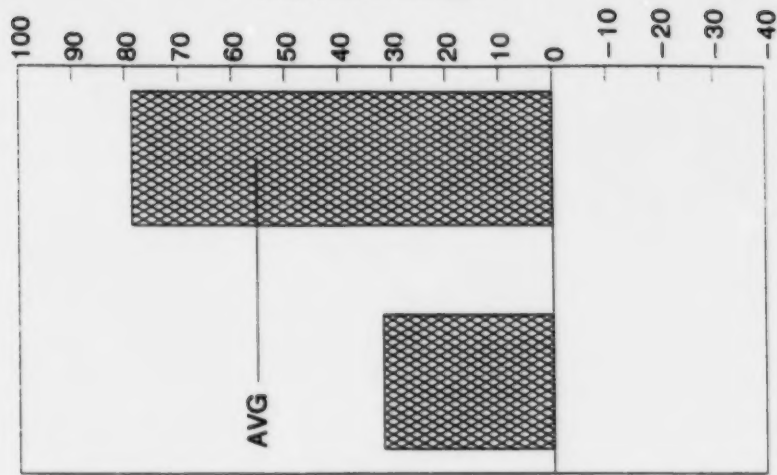
Conventional Tillage

WINTER WHEAT
High Returns



Minimum Tillage

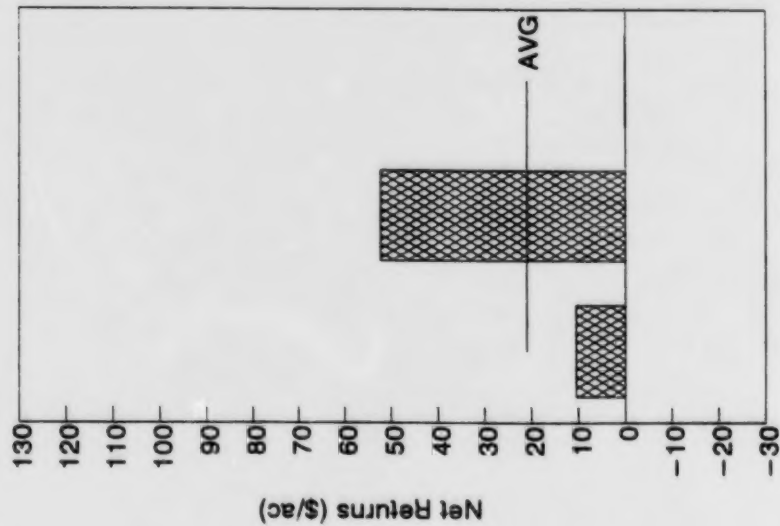
WINTER WHEAT
High Returns



No Tillage

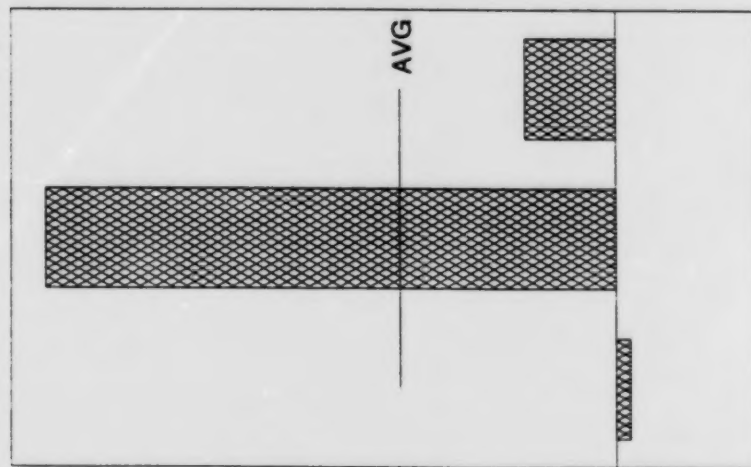
Soybeans
Low, Average, and High Returns

SOYBEANS Low Returns



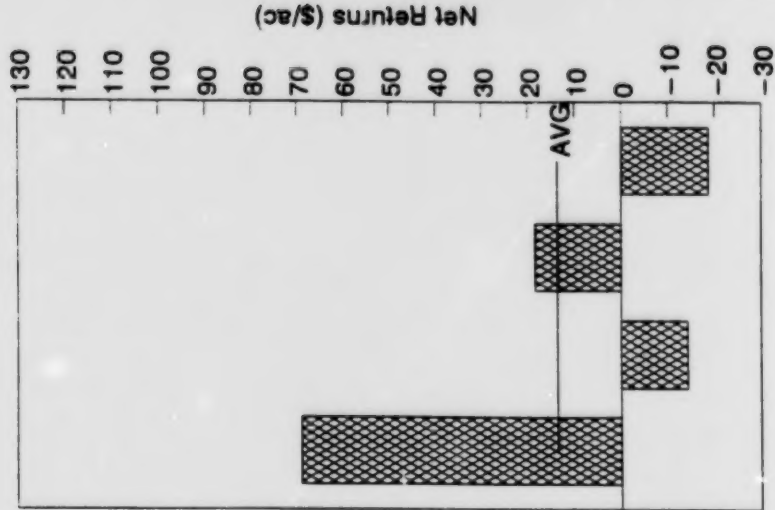
Conventional Tillage

SOYBEANS Low Returns



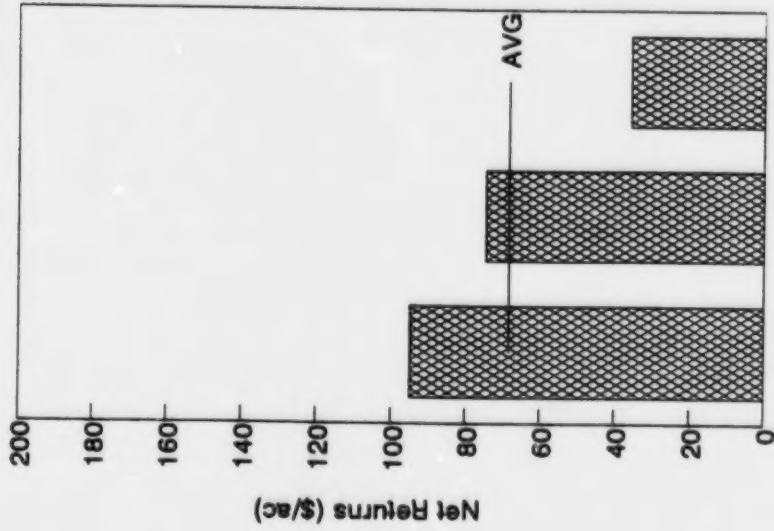
Minimum Tillage

SOYBEANS Low Returns



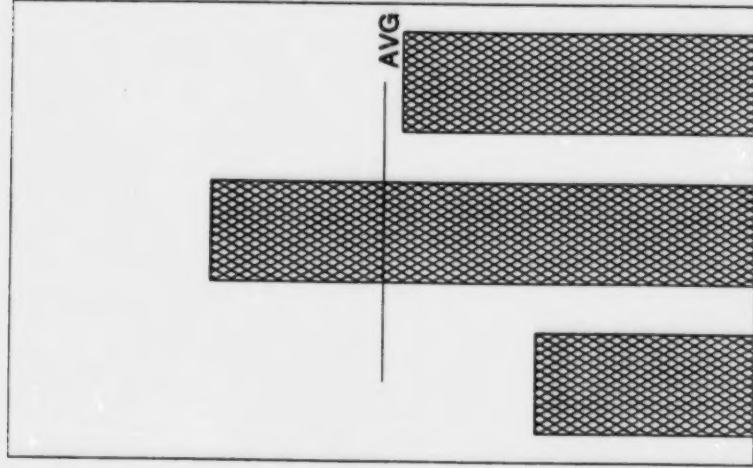
No Tillage

SOYBEANS
Average Returns



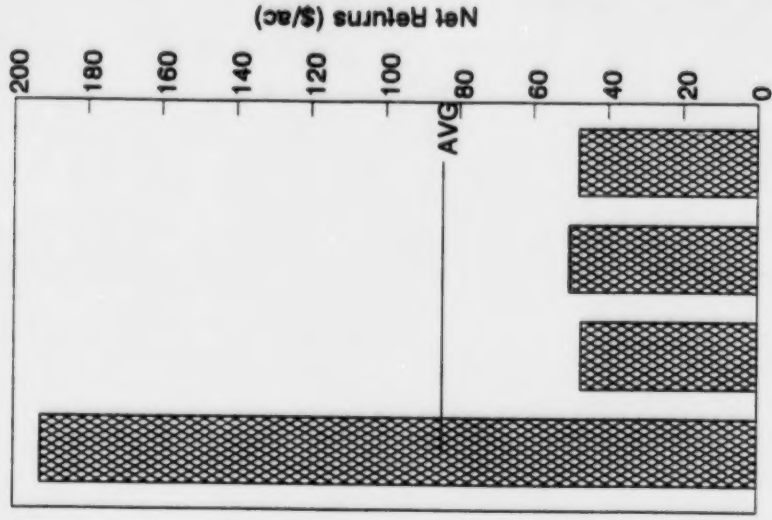
Conventional Tillage

SOYBEANS
Average Returns



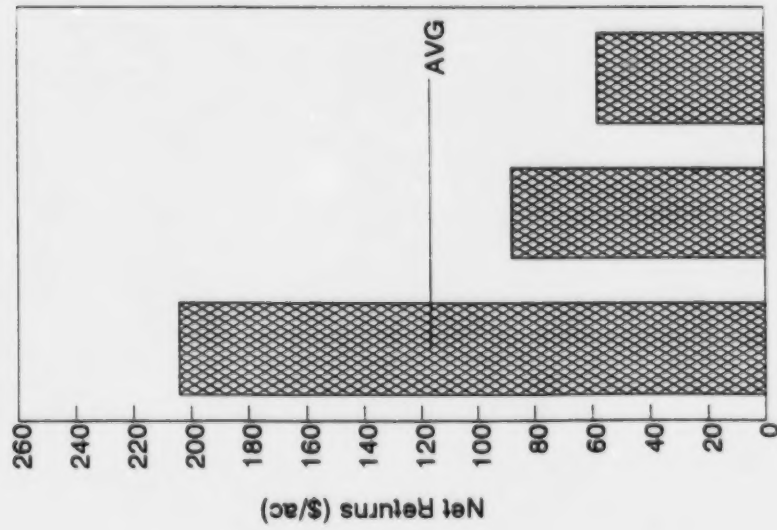
Minimum Tillage

SOYBEANS
Average Returns



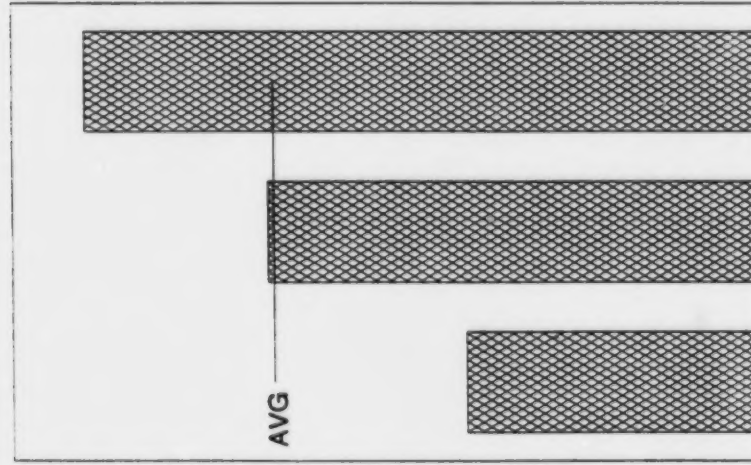
No Tillage

SOYBEANS
High Returns



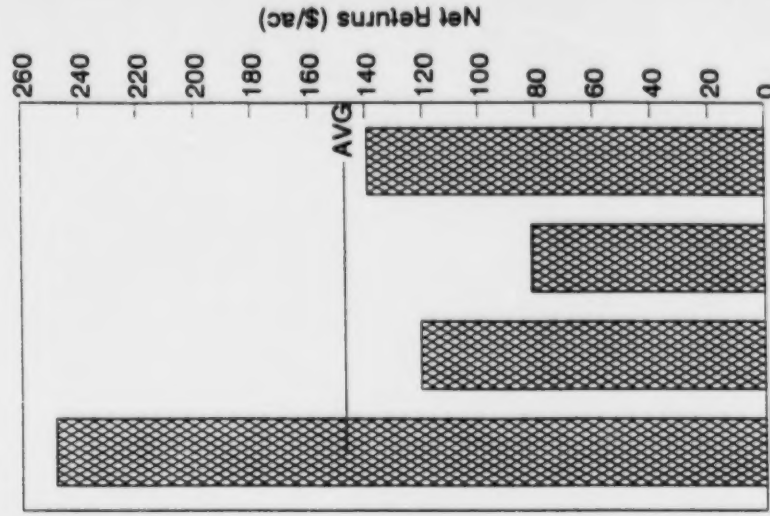
Conventional Tillage

SOYBEANS
High Returns



Minimum Tillage

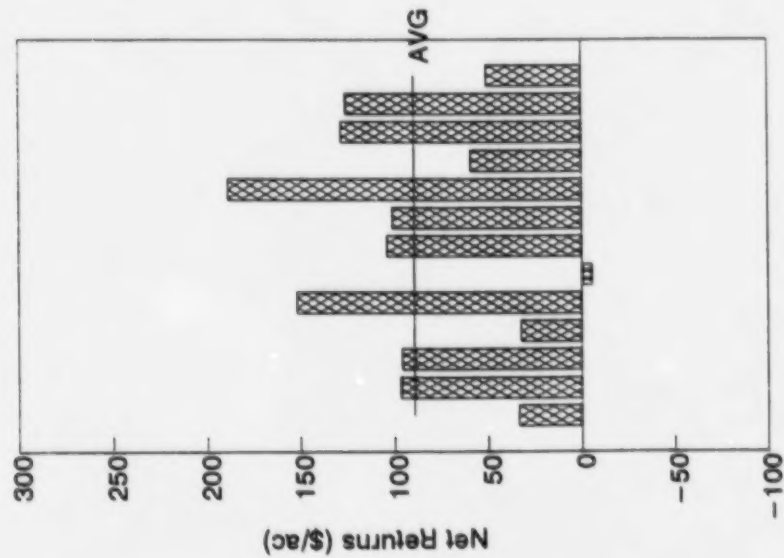
SOYBEANS
High Returns



No Tillage

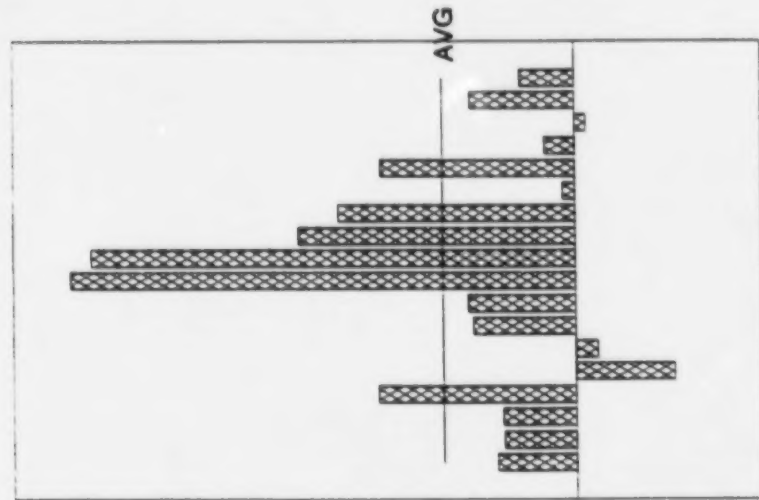
Corn
Low, Average, and High Returns

CORN
Low Returns



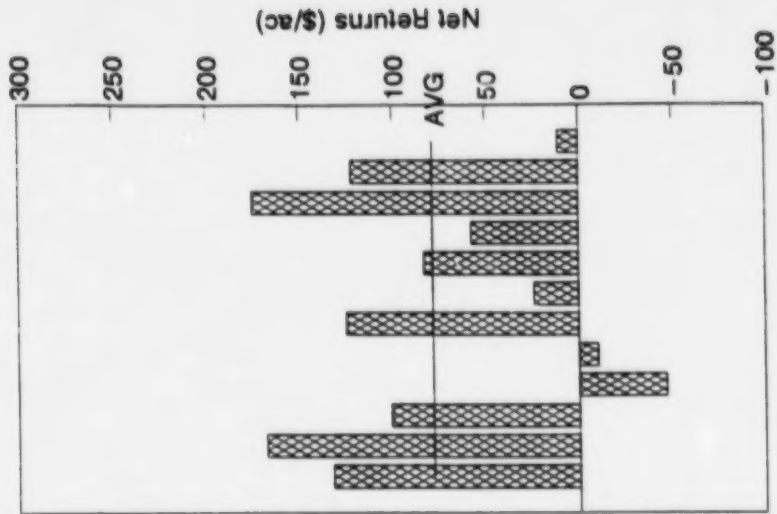
Conventional Tillage

CORN
Low Returns



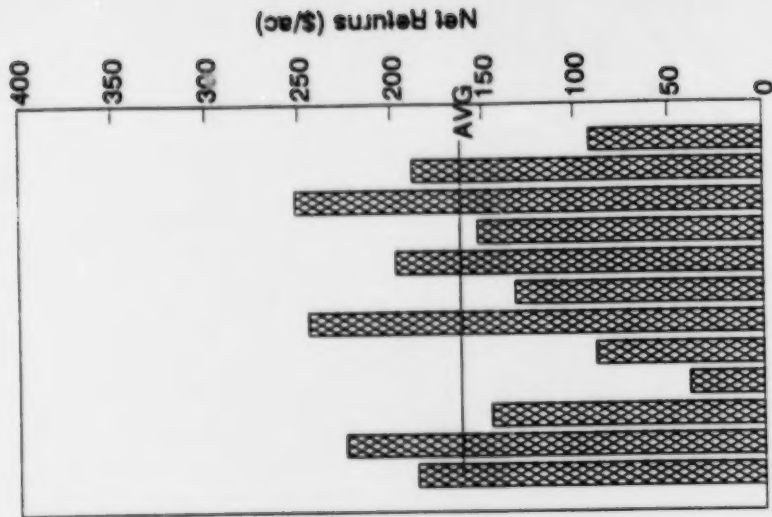
Minimum Tillage

CORN
Low Returns



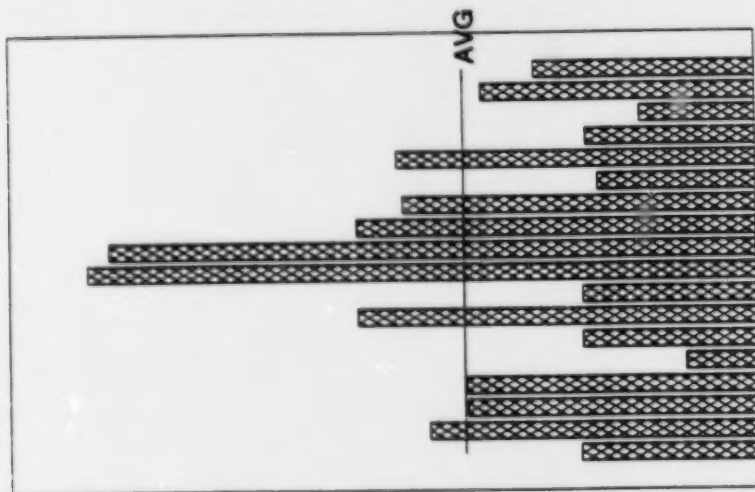
No Tillage

CORN
Average Returns



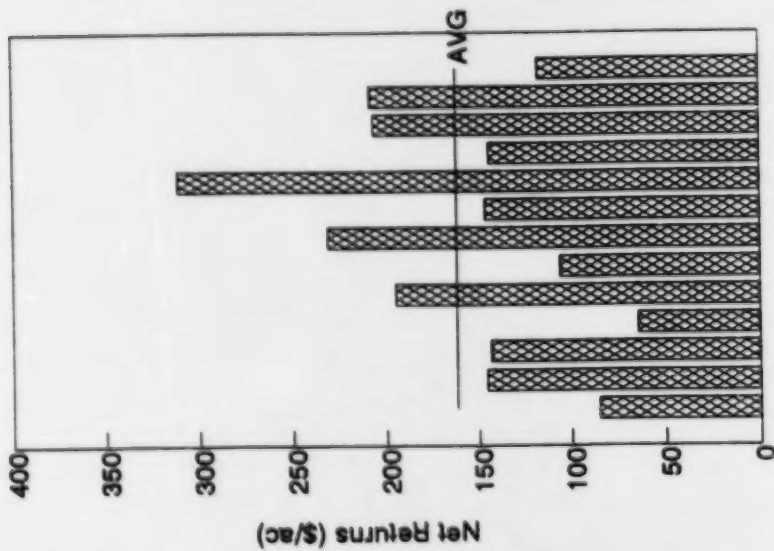
No Tillage

CORN
Average Returns



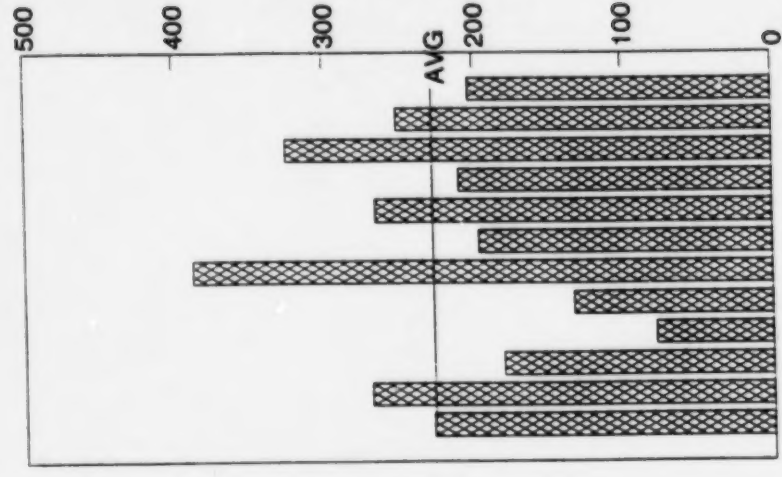
Minimum Tillage

CORN
Average Returns



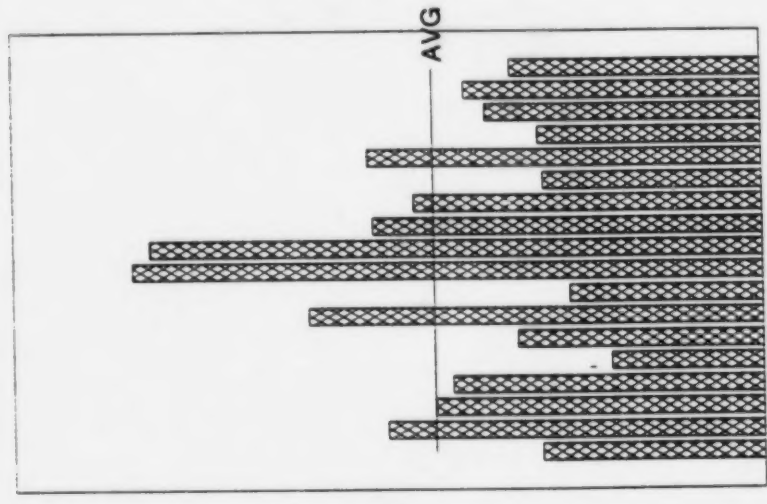
Conventional Tillage

CORN
High Returns



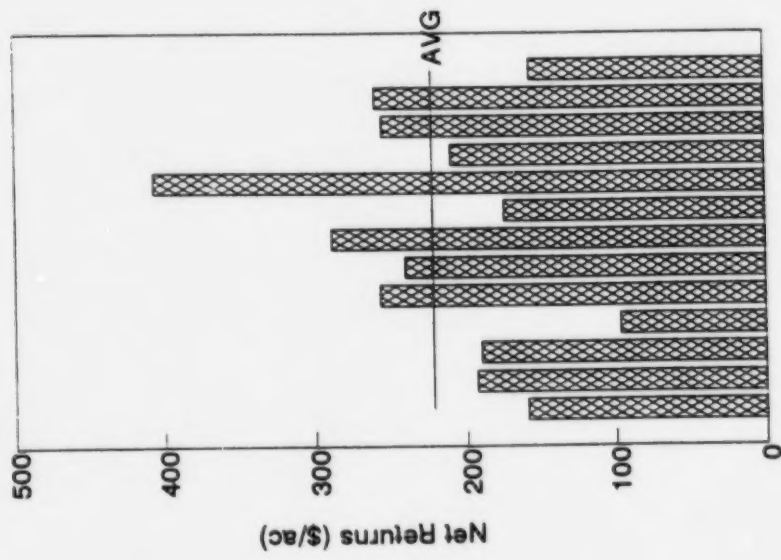
No Tillage

CORN
High Returns



Minimum Tillage

CORN
High Returns



Conventional Tillage

2

Winter Wheat
Comparison of Production Costs for Low, Average, and High Yields

Yield Variability and
Comparison of Production Costs
For Winter Wheat T-2000 Participants, 1986-88
Using Purchase Price for Machinery
(Dollars per Acre)

	A			B		
	Low	Conv. till	High	Low	Conv. till	High
W. WHEAT FIELDS CONVENTIONAL TILLAGE	-0.183	1-88	0.26	-0.208	1-88	0.173
Cost of Operations (OP)		62.76			117.10	
Total Material Costs (MA)	61.80	61.80	61.80	79.92	79.92	79.92
Fuel Costs		3.17			1.85	
Labour Costs		10.80			18.40	
TOTAL VARIABLE COST	76.77	75.77	75.77	100.17	100.17	100.17
TOTAL COSTS (OP+TVC)	138.53	138.53	138.53	217.27	217.27	217.27
Yield	21.98	26.90	33.68	31.68	40.00	46.92
Crop Price	3.80	3.80	3.80	3.80	3.80	3.80
TOTAL CROP REVENUE	83.51	102.22	126.80	120.38	152.00	178.30
Revenue - TC	-55.02	-36.31	-9.73	-66.89	-65.27	-38.97
Revenue - MA	21.71	40.42	67.00	40.46	72.08	98.38
Revenue - TVC	7.74	26.45	53.03	20.21	51.83	78.13
	C			D		
	Low	Min. till	High	Low	Min. till	High
W. WHEAT FIELDS MINIMUM TILLAGE	-0.184	2-88	0.105	-0.093	2-88	0.1
Cost of Operations (OP)		52.80			78.26	
Total Material Costs (MA)	61.80	61.80	61.80	80.95	80.88	80.88
Fuel Costs		2.25			1.33	
Labour Costs		10.00			8.50	
TOTAL VARIABLE COST	74.05	74.05	74.05	90.78	90.78	90.78
TOTAL COSTS (OP+TVC)	126.85	126.85	126.85	180.04	180.04	180.04
Yield	31.74	38.90	46.49	56.69	62.50	68.75
Crop Price	3.80	3.80	3.80	3.80	3.80	3.80
TOTAL CROP REVENUE	120.62	147.82	176.64	215.41	237.50	233.14
Revenue - TC	-6.23	20.97	49.79	46.37	68.46	92.21
Revenue - MA	58.82	86.02	114.84	134.46	156.95	180.30
Revenue - TVC	48.57	73.77	102.59	124.63	146.72	170.47
	E			F		
	Low	No till	High	Low	No till	High
W. WHEAT FIELDS NO TILLAGE	?	3-88	?	-0.086	3-88	0.15
Cost of Operations (OP)		37.91			49.82	
Total Material Costs (MA)	61.80	61.80	61.80	80.95	79.92	79.92
Fuel Costs		1.54			0.77	
Labour Costs		4.70			3.70	
TOTAL VARIABLE COST	68.04	68.04	68.04	90.63	84.36	84.36
TOTAL COSTS (OP+TVC)	105.95	105.95	105.95	173.79	134.21	143.26
Yield	40.80	40.80	40.80	68.10	34.73	43.70
Crop Price	3.80	3.80	3.80	3.80	3.80	3.80
TOTAL CROP REVENUE	155.04	155.04	155.04	258.78	131.98	166.06
Revenue - TC	48.09	48.09	48.09	-2.23	10.19	31.85
Revenue - MA	93.24	93.24	93.24	177.83	52.06	86.14
Revenue - TVC	87.00	87.00	87.00	168.15	60.01	81.67
	G			H		
	Low	No till	High	Low	No till	High
W. WHEAT FIELDS NO TILLAGE	?	3-88	?	-0.266	3-88	0.364
Cost of Operations (OP)		37.91			56.45	
Total Material Costs (MA)	61.80	61.80	61.80	80.95	80.88	80.88
Fuel Costs		1.54			0.53	
Labour Costs		4.70			3.4	
TOTAL VARIABLE COST	68.04	68.04	68.04	90.63	84.81	84.81
TOTAL COSTS (OP+TVC)	105.95	105.95	105.95	173.79	143.26	143.26
Yield	40.80	40.80	40.80	68.10	31.42	42.8
Crop Price	3.80	3.80	3.80	3.80	3.80	3.80
TOTAL CROP REVENUE	155.04	155.04	155.04	258.78	162.64	221.84
Revenue - TC	48.09	48.09	48.09	-2.23	10.19	31.85
Revenue - MA	93.24	93.24	93.24	177.83	81.76	140.96
Revenue - TVC	87.00	87.00	87.00	168.15	77.83	137.03

Soybeans

Comparison of Production Costs for Low, Average, and High Yields

Effect of Field Variability and Location of Production Costs

Comparison of Production Costs

For Southern T-2000 Participants: 1988-89

2000-2001 Import Price for Machinery

CHASSIS FILE

SOYBEAN FIELDS
CONVENTIONAL
TILLAGE

Cost of Operations (OP)	
Total Material Costs (MA)	
Fuel Costs	
Labour Costs	
TOTAL VARIABLE COST	
TOTAL COSTS (OP + MA)	
Yield	
Crop Price	
TOTAL CROP REVENUE	

	Revenue - TC	Revenue - MA	Revenue - TVC
--	--------------	--------------	---------------

SOYBEAN FIELDS MINIMUM TILLAGE

Cost of Operations (OP)	
Total Material Costs (MA)	
Fuel Costs	
Labour Costs	
TOTAL VARIABLE COST	
TOTAL COSTS (OP + MA)	
Yield	
Crop Price	
TOTAL CROP REVENUE	
Revenue - TC	
Revenue - MA	
Revenue - TVC	

**SOYBEAN FIELDS
NO TILLAGE**

Cost of Operations (OP)	
Total Material Costs (MA)	
Fuel Costs	
Labour Costs	
TOTAL VARIABLE COST	
TOTAL COSTS (OP + MA)	
Yield	
Crop Price	
TOTAL CROP REVENUE	
Revenue - TC	
Revenue - MA	
Revenue - TVC	

Corn

Comparison of Production Costs for Low, Average, and High Yields

**Yield Variability and
Comparison of Production Costs
For Corn T-2000 Participants, 1988-89
Using Purchase Price for Machinery
(Dollars per Acre)**

CORN FIELDS CONVENTIONAL TILLAGE	A					B					C					D					E					
	Low	Conv. till	High	Low	Conv. till	High	Low	Conv. till	High	Low	Conv. till	High	Low	Conv. till	High	Low	Conv. till	High	Low	Conv. till	High	Low	Conv. till	High		
Cost of Operations (OP)	103.84	93.52	103.84	135.56	152.35	135.56	105.50	174.41	105.50	105.50	105.50	105.50	68.61	156.57	68.61	78.6	90.85	68.61	78.6	78.6	78.6	78.6	78.6	78.6		
Total Material Costs (MA)	103.84	103.84	103.84	135.56	135.56	135.56	105.50	174.41	105.50	105.50	105.50	105.50	88.61	156.57	88.61	78.6	90.85	88.61	78.6	78.6	78.6	78.6	78.6	78.6		
Fuel Costs	10.80	2.61	10.80	10.80	8.50	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80		
Labour Costs	117.25	117.25	117.25	144.63	144.63	144.63	115.59	115.59	115.59	115.59	115.59	115.59	81.20	81.20	81.20	81.20	81.20	81.20	81.20	81.20	81.20	81.20	81.20	81.20		
TOTAL VARIABLE COST	197.36	197.36	197.36	287.91	287.91	287.91	229.91	229.91	229.91	229.91	229.91	229.91	197.36	197.36	197.36	197.36	197.36	197.36	197.36	197.36	197.36	197.36	197.36	197.36		
TOTAL COSTS (OP + MA)	211.68	211.68	211.68	271.17	271.17	271.17	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68	211.68		
Yield	71.08	87.00	100.62	118.37	133.30	147.96	115.62	130.20	144.52	154.52	169.20	184.52	199.20	214.52	229.20	244.52	259.20	274.52	289.20	304.52	319.20	334.52	349.20	364.52		
Crop Price	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25		
TOTAL CROP REVENUE	231.01	282.75	325.27	384.70	433.23	480.86	375.78	423.15	469.77	517.77	565.77	613.77	661.77	709.77	757.77	805.77	853.77	901.77	949.77	997.77	1045.77	1093.77	1141.77	1189.77		
Revenue - TC	33.65	85.30	136.91	188.52	240.13	291.74	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13	240.13		
Revenue - MA	127.17	178.91	230.65	282.39	334.13	385.87	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13	334.13		
Revenue - TVC	113.76	185.50	239.02	240.07	288.60	336.25	260.17	307.56	354.11	384.11	431.11	478.11	525.11	572.11	619.11	666.11	713.11	760.11	807.11	854.11	901.11	948.11	995.11	1042.11		
CORN FIELDS MINIMUM TILLAGE	A					B					C					D					E					
	Low	Min. till	High	Low	Min. till	High	Low	Min. till	High	Low	Min. till	High	Low	Min. till	High	Low	Min. till	High	Low	Min. till	High	Low	Min. till	High		
Cost of Operations (OP)	100.83	85.23	100.83	135.56	119.33	135.56	113.62	95.34	113.62	113.62	113.62	113.62	78.6	84.37	78.6	101.33	130.85	78.6	101.33	101.33	101.33	101.33	101.33	101.33		
Total Material Costs (MA)	100.83	100.83	100.83	135.56	135.56	135.56	113.62	95.34	113.62	113.62	113.62	113.62	78.6	84.37	78.6	101.33	130.85	78.6	101.33	101.33	101.33	101.33	101.33	101.33		
Fuel Costs	10.80	2.08	10.80	10.80	7.00	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80		
Labour Costs	112.08	112.08	112.08	142.08	142.08	142.08	119.68	119.68	119.68	119.68	119.68	119.68	88.64	88.64	88.64	113.08	113.08	88.64	113.08	113.08	113.08	113.08	113.08	113.08		
TOTAL VARIABLE COST	186.08	186.08	186.08	254.88	254.88	254.88	208.96	208.96	208.96	208.96	208.96	208.96	186.08	186.08	186.08	221.96	221.96	186.08	221.96	221.96	221.96	221.96	221.96	221.96		
TOTAL COSTS (OP + MA)	208.91	208.91	208.91	271.44	271.44	271.44	224.58	224.58	224.58	224.58	224.58	224.58	208.91	208.91	208.91	243.31	243.31	208.91	243.31	243.31	243.31	243.31	243.31	243.31		
Yield	70.18	86.00	102.77	120.23	132.30	155.72	111.80	127.25	144.52	161.79	179.06	196.33	213.60	230.87	248.14	265.41	282.68	300.00	317.27	334.54	351.81	369.08	386.35	403.62		
Crop Price	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25		
TOTAL CROP REVENUE	226.07	279.50	334.00	390.24	429.98	506.08	375.78	423.15	469.77	517.77	565.77	613.77	661.77	709.77	757.77	805.77	853.77	901.77	949.77	997.77	1045.77	1093.77	1141.77	1189.77		
Revenue - TC	42.01	93.44	147.84	202.24	256.64	311.04	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64	256.64		
Revenue - MA	127.24	178.67	233.17	282.45	334.19	385.93	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19	334.19		
Revenue - TVC	115.98	187.41	229.91	240.07	288.60	336.25	260.17	307.56	354.11	384.11	431.11	478.11	525.11	572.11	619.11	666.11	713.11	760.11	807.11	854.11	901.11	948.11	995.11	1042.11		
CORN FIELDS NO TILLAGE	A					B					C					D					E					
	Low	No till	High	Low	No till	High	Low	No till	High	Low	No till	High	Low	No till	High	Low	No till	High	Low	No till	High	Low	No till	High		
Cost of Operations (OP)	135.56	92.88	135.56	118.12	95.44	118.12	93.08	105.41	118.12	118.12	118.12	118.12	88.61	119.7	88.61	101.33	108.48	88.61	101.33	101.33	101.33	101.33	101.33	101.33		
Total Material Costs (MA)	135.56	135.56	135.56	118.12	118.12	118.12	93.08	105.41	118.12	118.12	118.12	118.12	88.61	119.7	88.61	101.33	108.48	88.61	101.33	101.33	101.33	101.33	101.33	101.33		
Fuel Costs	10.80	5.00	10.80	10.80	4.50	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80		
Labour Costs	140.74	140.74	140.74	123.14	123.14	123.14	102.01	102.01	102.01	102.01	102.01	102.01	111.64	111.64	111.64	111.64	111.64	111.64	111.64	111.64	111.64	111.64	111.64	111.64		
TOTAL VARIABLE COST	228.24	228.24	228.24	213.56	213.56	213.56	198.48	198.48	198.48	198.48	198.48	198.48	221.03	221.03	221.03	221.03	221.03	221.03	221.03	221.03	221.03	221.03	221.03	221.03		
TOTAL COSTS (OP + MA)	363.80	363.80	363.80	331.70	331.70	331.70	311.96	311.96	311.96	311.96	311.96	311.96	332.67	332.67	332.67	332.67	332.67	332.67	332.67	332.67	332.67	332.67	332.67	332.67		
Yield	110.93	127.50	140.36	117.28	134.80	148.41	115.62	130.20	144.52	154.52	169.20	184.52	199.20	214.52	229.20	244.52	259.20	274.52	289.20	304.52	319.20	334.52	349.20	364.52		
Crop Price	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25		
TOTAL CROP REVENUE	360.51	414.36	456.23	381.15	438.10	482.35	375.78	423.15	469.77	517.77	565.77	613.77	661.77	709.77	757.77	805.77	853.77	901.77	949.77	997.77	1045.77	1093.77	1141.77	1189.77		
Revenue - TC	132.27	188.14	227.98	167.59	224.54	268.79	200.84	245.96	287.91	329.86	371.81	413.76	455.71	497.66	539.61	581.56	623.51	665.46	707.41	749.36	791.31	833.26	875.21	917.16		
Revenue - MA	224.95	276.82	320.67	263.03	314.90	358.25	282.39	334.13	385.87	437.61	489.35	541.09	592.83	644.57	696.31	748.05	799.79	851.53	903.27	955.01	1006.75	1058.49	1110.23	1161.97		
Revenue - TVC	115.98	187.41	229.91	107.42	169.64	213.54	118.45	170.81	215.12	259.43	303.74	348.05	392.36	436.67	480.98	525.29	569.60	613.91	658.22	702.53	746.84	791.15	835.46	879.77		

CORN FIELDS CONVENTIONAL TILLAGE	F				G				H				I				J			
	Low -0.314	Conv. till 60	80 1-80	High 0.376	Low -0.281	Conv. till 62	82 1-82	High 0.127	Low -0.111	Conv. till 67	87 1-86	High 0.088	Low -0.214	Conv. till 69	89 1-87	High 0.166	Low -0.214	Conv. till 72	88 1-88	High 0.166
Cost of Operations (OP)	121.47	166.62	55.33	127.82	55.33	109.34	109.34	151.54	128.08	132.74	132.74	132.74	133.44	117.88	133.44	133.44	133.44	133.44	133.44	133.44
Total Material Costs (MA)	127.82	127.82	55.33	127.82	55.33	109.34	109.34	151.54	128.08	132.74	132.74	132.74	133.44	117.88	133.44	133.44	133.44	133.44	133.44	133.44
Fuel Costs	2.17	3.34	20.3	13.8	7.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	7.8	13.8	13.8	13.8	13.8	13.8	7.8
Labour Costs	16.3	78.97	78.97	146.26	78.97	124.06	124.06	124.06	124.06	141.80	141.80	141.80	142.58	142.58	141.80	141.80	142.58	142.58	142.58	142.58
TOTAL VARIABLE COST	146.26	221.95	221.95	246.26	221.95	221.95	221.95	221.95	221.95	261.42	261.42	261.42	251.32	251.32	261.42	261.42	251.32	251.32	251.32	251.32
TOTAL COSTS (OP + MA)	249.29	355.23	355.23	392.52	355.23	355.23	355.23	355.23	355.23	383.17	383.17	383.17	372.70	372.70	383.17	383.17	372.70	372.70	372.70	372.70
Yield	74.96	106.3	106.3	150.62	100.23	130.4	130.4	157.10	111.36	125.3	125.3	125.3	125.3	121.8	125.3	125.3	125.3	125.3	125.3	121.8
Crop Price	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
TOTAL CROP REVENUE	243.68	355.23	355.23	489.50	325.74	453.05	453.05	510.59	362.02	407.23	407.23	434.62	450.36	365.20	450.36	450.36	310.83	365.20	365.20	460.80
Revenue - TC	-5.61	105.93	105.93	240.21	103.79	231.10	231.10	288.64	101.14	146.34	146.34	174.04	188.94	143.88	188.94	188.94	59.31	143.88	143.88	209.48
Revenue - MA	115.90	227.41	227.41	361.68	270.41	387.72	387.72	455.26	252.68	297.86	297.86	325.58	317.82	261.76	317.82	317.82	177.19	261.76	261.76	327.36
Revenue - TVC	67.30	208.64	208.64	343.21	246.77	374.08	374.08	431.82	237.36	282.56	282.56	310.26	308.96	252.82	282.56	282.56	168.08	252.82	252.82	318.22
CORN FIELDS MINIMUM TILLAGE																				
Cost of Operations (OP)	115.24	164.72	55.33	101.49	55.33	100.34	100.34	167.86	132.34	132.74	132.74	132.74	132.74	140.35	132.74	132.74	132.74	132.74	132.74	132.74
Total Material Costs (MA)	101.48	101.48	55.33	101.48	55.33	100.34	100.34	167.86	132.34	132.74	132.74	132.74	132.74	140.35	132.74	132.74	132.74	132.74	132.74	132.74
Fuel Costs	3.97	3.24	19.8	7.3	7.3	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
Labour Costs	114.76	114.76	78.37	114.76	78.37	78.37	78.37	78.37	125.61	143.17	143.17	143.17	143.17	142.26	143.17	143.17	143.17	143.17	143.17	142.26
TOTAL VARIABLE COST	216.73	216.73	220.05	216.73	220.05	220.05	220.05	220.05	277.20	298.08	298.08	298.08	298.08	273.09	298.08	298.08	273.09	273.09	273.09	273.09
TOTAL COSTS (OP + MA)	63.11	94.9	117.11	84.51	133.3	160.89	160.89	113.5	124.85	164.36	164.36	164.36	163.53	160.8	164.36	164.36	163.53	160.8	160.8	209.86
Yield	63.11	94.9	117.11	84.51	133.3	160.89	160.89	113.5	124.85	164.36	164.36	164.36	163.53	160.8	164.36	164.36	163.53	160.8	160.8	209.86
Crop Price	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
TOTAL CROP REVENUE	205.10	308.43	380.60	274.66	433.23	522.90	522.90	334.57	368.88	405.76	405.76	534.28	622.70	619.45	622.70	622.70	531.49	619.45	619.45	661.40
Revenue - TC	-11.63	91.70	163.87	54.61	213.16	302.85	302.85	57.37	91.67	126.56	126.56	269.20	357.82	408.31	357.82	357.82	258.40	357.82	357.82	408.31
Revenue - MA	103.61	206.94	279.11	219.33	377.90	487.57	487.57	225.23	259.54	296.42	296.42	401.94	489.96	548.06	489.96	489.96	398.76	489.96	489.96	548.06
Revenue - TVC	90.34	193.67	265.84	196.29	354.86	444.53	444.53	208.96	243.27	280.15	280.15	391.11	479.53	539.14	479.53	479.53	389.23	479.53	479.53	539.14
CORN FIELDS NO TILLAGE																				
Cost of Operations (OP)	84.3	107.67	76.62	127.82	111.61	111.61	111.61	111.61	97.06	97.06	97.06	97.06	126.33	112.69	126.33	126.33	126.33	126.33	126.33	126.33
Total Material Costs (MA)	127.82	127.82	127.82	127.82	111.61	111.61	111.61	111.61	97.06	97.06	97.06	97.06	126.33	112.69	126.33	126.33	126.33	126.33	126.33	126.33
Fuel Costs	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Labour Costs	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
TOTAL VARIABLE COST	134.74	134.74	134.74	134.74	118.43	118.43	118.43	118.43	105.72	105.72	105.72	105.72	131.62	131.62	131.62	131.62	131.62	131.62	131.62	131.62
TOTAL COSTS (OP + MA)	212.12	212.12	212.12	212.12	210.28	210.28	210.28	210.28	174.60	174.60	174.60	174.60	239.02	239.02	239.02	239.02	239.02	239.02	239.02	239.02
Yield	103.60	140.5	140.5	194.34	74.84	108	108	127.06	78.28	114.4	114.4	135.56	66.11	95.4	114.4	114.4	127.44	151	151	173.50
Crop Price	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
TOTAL CROP REVENUE	336.90	456.63	456.63	599.09	243.24	351.00	351.00	415.94	257.66	371.80	371.80	440.58	214.86	310.05	310.05	310.05	414.19	490.75	490.75	563.87
Revenue - TC	124.87	244.51	244.51	366.97	23.96	131.72	131.72	190.66	83.06	167.20	167.20	265.08	97.31	152.50	152.50	152.50	175.17	251.73	251.73	324.85
Revenue - MA	206.17	328.61	328.61	471.27	131.63	239.30	239.30	359.68	273.82	342.60	342.60	411.90	287.86	364.42	364.42	364.42	287.86	364.42	364.42	437.54
Revenue - TVC	202.25	321.80	321.80	464.35	124.81	232.57	232.57	297.51	151.94	266.08	266.08	334.86	127.14	222.33	222.33	222.33	279.69	282.57	282.57	359.13

CORN FIELDS	K	L	M
CONVENTIONAL TILLAGE	Conv. till 81 Low -0.176 High 0.112	Conv. till 83 Low -0.179 High 0.112	Conv. till 103 Low -0.205 High 0.121
Cost of Operations (OP)	113.84	136.44	128.34
Total Material Costs (MA)	115.34	113.66	78.4
Fuel Costs	0.87	3.25	2.32
Labour Costs	7.2	17	13.7
TOTAL VARIABLE COST	123.41	133.91	94.42
TOTAL COSTS (OP + MA)	229.16	250.10	206.74
Yield	110.01	149.01	111.85
Crop Price	3.25	3.25	3.25
TOTAL CROP REVENUE	357.55	484.26	323.70
Revenue - TC	128.37	126.12	156.13
Revenue - MA	242.21	368.94	284.47
Revenue - TVC	234.14	360.87	266.45
CORN FIELDS MINIMUM TILLAGE	J	J	P
	Min. till 73 Low -0.142 High 0.1	Min. till 74 Low -0.142 High 0.1	Min. till 75 Low -0.23 High 0.187
Cost of Operations (OP)	115.72	114.95	156.60
Total Material Costs (MA)	133.43	133.44	92.59
Fuel Costs	1.22	1.34	1.42
Labour Costs	7.2	6.1	8.4
TOTAL VARIABLE COST	141.85	143.88	102.21
TOTAL COSTS (OP + MA)	249.15	248.30	251.28
Yield	122.18	142.4	103
Crop Price	3.25	3.25	3.25
TOTAL CROP REVENUE	367.08	509.08	397.35
Revenue - TC	147.93	126.66	146.07
Revenue - MA	263.65	375.65	354.53
Revenue - TVC	255.23	367.23	344.89
CORN FIELDS NO TILLAGE	S	S	R
	No till 84 Low -0.156 High 0.140	No till 102 Low -0.206 High 0.364	No till 77 Low -0.23 High 0.187
Cost of Operations (OP)	96.52	53.8	146.38
Total Material Costs (MA)	138.22	159.46	83.26
Fuel Costs	1.3	0.47	1.66
Labour Costs	8.4	5.3	5.3
TOTAL VARIABLE COST	147.92	165.23	102.21
TOTAL COSTS (OP + MA)	234.74	213.26	229.84
Yield	100.80	93.9	94.2
Crop Price	3.25	3.25	3.25
TOTAL CROP REVENUE	356.86	416.26	378.83
Revenue - TC	122.12	10.74	149.10
Revenue - MA	218.64	347.61	295.57
Revenue - TVC	208.94	337.91	286.59

CORN FIELDS CONVENTIONAL TILLAGE		S					M					M				
		Low	Min. till	High	Low	High	Min. till	Low	High	Low	High	Min. till	Low	High		
		-0.241	2-80	0.447	-0.252	0.152	2-80	-0.252	0.152	-0.252	0.152	2-80	-0.252	0.152		
CORN FIELDS MINIMUM TILLAGE																
Cost of Operations (OP)		55.89					120.17					138.9				
Total Material Costs (MA)		150.46					76.4					76.4				
Fuel Costs		0.46					1.82					2.59				
Labour Costs		6.7					10.9					15.2				
TOTAL VARIABLE COST		166.64					91.12					96.19				
TOTAL COSTS (OP + MA)		215.35					196.57					217.30				
Yield		85					106					102.7				
Crop Price		3.25					3.25					3.25				
TOTAL CROP REVENUE		209.67					344.50					333.78				
Revenue - TC		-5.68					145.93					116.46				
Revenue - MA		50.21					266.10					255.36				
Revenue - TVC		43.03					253.38					237.59				
CORN FIELDS NO TILLAGE																
Cost of Operations (OP)		60.90					184.36					198.29				
Total Material Costs (MA)		116.76					240.27					318.46				
Fuel Costs																
Labour Costs																
TOTAL VARIABLE COST		166.64					91.12					96.19				
TOTAL COSTS (OP + MA)		215.35					196.57					217.30				
Yield		85					106					102.7				
Crop Price		3.25					3.25					3.25				
TOTAL CROP REVENUE		209.67					344.50					333.78				
Revenue - TC		-5.68					145.93					116.46				
Revenue - MA		50.21					266.10					255.36				
Revenue - TVC		43.03					253.38					237.59				

Winter Wheat
Breakeven Analysis with T-2000, Decade High, and Decade Low Prices

Wield Verleibility and

	A			B		
	Conv. till 1-88	St Dev. 14.6	% Below Breakeven	Conv. till 1-88	St Dev. 10.3	% Below Breakeven
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	82.78			117.10		
Total Material Costs (MA)	81.80			79.92		
Fuel Costs	3.17			1.85		
Labour Costs	10.80			18.40		
TOTAL VARIABLE COST	75.77			100.17		
TOTAL COSTS (OP + TVC)	138.53			217.27		
Yield	26.90			40.00		
Crop Price	3.80			3.80		
TOTAL CROP REVENUE	102.22			152.00		
BREAK-EVEN YIELD						
TVC	19.94	-0.48	31.56%	26.36	-1.32	9.34%
TC	36.46	0.65	74.22%	57.18	1.87	95.25%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	52.80			78.26		
Total Material Costs (MA)	81.80			80.88		
Fuel Costs	2.25			1.33		
Labour Costs	10.00			8.50		
TOTAL VARIABLE COST	74.05			86.25		
TOTAL COSTS (OP + TVC)	126.85			149.50		
Yield	38.90			42.40		
Crop Price	3.80			3.80		
TOTAL CROP REVENUE	147.82			161.12		
BREAK-EVEN YIELD						
TVC	19.40	-1.88	3.01%	23.88	-5.44	0.00%
TC	33.38	-0.54	29.46%	44.48	-2.54	0.55%
		Z			Z	
W. WHEAT FIELDS NO TILLAGE						
Cost of Operations (OP)	37.91			83.16		
Total Material Costs (MA)	81.80			80.95		
Fuel Costs	1.54			1.16		
Labour Costs	4.70			8.50		
TOTAL VARIABLE COST	86.04			90.63		
TOTAL COSTS (OP + TVC)	105.95			173.70		
Yield	40.80			68.10		
Crop Price	3.80			3.80		
TOTAL CROP REVENUE	155.04			258.78		
BREAK-EVEN YIELD						
TVC	17.01	ERR		23.85	ERR	
TC	27.88	ERR		45.73	ERR	
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	58.45			40.82		
Total Material Costs (MA)	80.88			79.92		
Fuel Costs	3.4			0.77		
Labour Costs	84.81			3.70		
TOTAL VARIABLE COST	143.26			124.21		
TOTAL COSTS (OP + TVC)	42.8			38.00		
Yield	3.80			3.80		
Crop Price	162.84			144.40		
TOTAL CROP REVENUE						
BREAK-EVEN YIELD						
TVC	22.32	-0.96	4.05%	22.21	-1.74	4.05%
TC	37.70	-0.24	38.59%	35.32	-0.20	38.59%
		Z			Z	
W. WHEAT FIELDS MINIMUM TILLAGE						

Yield Variability and

2

Yield Variability and
BREAKEVEN ANALYSIS WITH DECADE LOW PRICE
For Winter Wheat T-2000 Participants, 1986-88
Using Purchase Price for Machinery
(Dollars per Acre)

	A			B		
	Conv. till	1	St. Dev.	% Below	26	% Below
W. WHEAT FIELDS CONVENTIONAL TILLAGE	1-86		14.6	Break-even	1-88	10.3 Break-even
Cost of Operations (OP)	62.76				117.10	
Total Material Costs (MA)	61.80				79.92	
Fuel Costs	3.17				1.85	
Labour Costs	10.80				18.40	
TOTAL VARIABLE COST	75.77				100.17	
TOTAL COSTS (OP+TVC)	136.53				217.27	
Yield	28.90				40.00	
Crop Price	3.00				3.00	
TOTAL CROP REVENUE	80.70				120.00	
BREAKEVEN YIELD						
TVC	25.26	-0.11	45.62%		33.39	-0.64 26.11%
TC	48.18	1.32	90.96%		72.42	3.15 99.91%
	C			D		
	Min. till	22	St. Dev.	% Below	26	% Below
W. WHEAT FIELDS MINIMUM TILLAGE	2-86	2-88	10.3	Break-even	2-88	26 Break-even
Cost of Operations (OP)	52.60				63.34	
Total Material Costs (MA)	61.80				80.88	
Fuel Costs	2.25				0.87	
Labour Costs	10.00				4.70	
TOTAL VARIABLE COST	74.05				86.25	
TOTAL COSTS (OP+TVC)	126.85				149.59	
Yield	36.90				42.40	
Crop Price	3.00				3.00	
TOTAL CROP REVENUE	116.70				127.20	
BREAKEVEN YIELD						
TVC	24.68	-1.38	8.38%		28.75	-0.52 30.15%
TC	42.26	0.33	62.93%		49.89	0.29 61.41%
	E			F		
	Conv. till	3	St. Dev.	% Below	27	% Below
W. WHEAT FIELDS NO TILLAGE	3-86		7	Break-even	3-88	8.1 Break-even
Cost of Operations (OP)	37.91				49.45	
Total Material Costs (MA)	61.80				80.88	
Fuel Costs	1.54				0.53	
Labour Costs	4.70				3.4	
TOTAL VARIABLE COST	66.04				84.81	
TOTAL COSTS (OP+TVC)	105.95				143.26	
Yield	40.80				42.8	
Crop Price	3.00				3.00	
TOTAL CROP REVENUE	122.40				128.40	
BREAKEVEN YIELD						
TVC	22.68	ERR	ERR		28.27	-0.68 24.83%
TC	35.32	ERR	ERR		47.75	0.23 56.10%

Soybeans

Breakeven Analysis with T-2000, Decade High, and Decade Low Prices

Yield Variability and

	A			B			C		
	Conv. till	St Dev.	% Below Break-even	Conv. till	St Dev.	% Below Break-even	Conv. till	St Dev.	% Below Break-even
	1-88	19.6	19.6	1-87	8.1	8.1	1-88	7.6	7.6
SOYBEAN FIELDS									
CONVENTIONAL									
TILLAGE									
Cost of Operations (OP)	136.57			70.10			75.57		
Total Material Costs (MA)	48.23			54.23			87.60		
Fuel Costs	3.95			2.10			1.76		
Labour Costs	22.50			16.70			12.90		
TOTAL VARIABLE COST	74.26			72.03			102.26		
TOTAL COSTS (OP + MA)	184.80			124.33			163.17		
Yield	30.40			28.00			28.00		
Crop Price	7.10			7.10			7.10		
TOTAL CROP REVENUE	279.74			198.80			198.80		
BREAKEVEN YIELD		2			2			2	
TVC	10.46	-1.48	6.94%	10.20	-2.00	0.10%	14.40	-1.70	3.87%
TC	26.03	-0.66	24.83%	17.51	-1.72	4.27%	22.98	-0.60	25.46%

	D	B	E
	Min. till 13 1-86	Min. till 34 2-87	Min. till 41 2-87
	St Dev. 10.3	St Dev. 7.1	St Dev. 26
	% Below Break-even	% Below Break-even	% Below Break-even
Cost of Operations (OP)	58.06	35.42	127.30
Total Material Costs (MA)	67.79	69.91	90.88
Fuel Costs	0.92	0.76	1.80
Labour Costs	9.00	0.10	8.70
TOTAL VARIABLE COST	77.71	70.77	101.38
TOTAL COSTS (OP + MA)	125.87	105.33	218.27
Yield	26.00	35.40	44.10
Crop Price	7.10	7.10	7.10
TOTAL CROP REVENUE	184.80	251.34	313.11
BREAKEVEN YIELD	10.05	9.07	14.28
TVC	17.73	14.84	30.74
TC	-0.92	-3.58	-1.19
	-0.51	-2.80	-0.51
	17.85%	0.06%	12.51%
	30.50%	0.19%	30.50%

	D	A	C	E
	No till 14 3-80	No till 20 3-88	No till 36 3-88	No till 42 3-87
	St Dev. 12.4	St Dev. 10	St Dev. 7.3	St Dev. 21.4
	% Below Break-even	% Below Break-even	% Below Break-even	% Below Break-even
Soybean Fields No Tillage				
Cost of Operations (OP)	134.23	139.57	87.82	111.91
Total Material Costs (MA)	47.13	48.23	87.60	90.9
Fuel Costs	2.85	2.88	1.31	1.53
Labour Costs	15.20	18.30	10.40	7
TOTAL VARIABLE COST	64.88	69.41	99.31	99.43
TOTAL COSTS (OP + MA)	181.36	187.80	155.42	202.81
Yield	52.70	33.10	29.00	35.3
Crop Price	7.10	7.10	7.10	7.10
TOTAL CROP REVENUE	374.17	235.01	205.90	250.63
BREAKEVEN YIELD	9.15	9.78	13.90	14.00
PAC	-3.51	0.07%	-2.00	-0.31
	2	2	2	2
	15.87%	10.93%	1.97%	15.87%
	37.83%	-0.00%	-0.00%	37.83%

**Yield Variability and
BREAK-EVEN ANALYSIS WITH DECADE LOW PRICE
For Soybean Y-2000 Participants, 1988-88
Using Purchase Price for Machinery
(Dollars per Acre)**

	A			B			C		
	Conv. till 28	St. Dev. 18.6	% Below Break-even	Conv. till 33	St. Dev. 6.1	% Below Break-even	Conv. till 35	St. Dev. 7.8	% Below Break-even
SOYBEAN FIELDS CONVENTIONAL TILLAGE	1-88			1-87			1-88		
Cost of Operations (OP)	136.57			70.10			75.57		
Total Material Costs (MA)	48.23			54.23			87.80		
Fuel Costs	3.55			2.10			1.76		
Labour Costs	22.50			16.70			12.90		
TOTAL VARIABLE COST	74.28			73.03			102.26		
TOTAL COSTS (OP + MA)	184.80			124.33			183.17		
Yield	39.40			28.00			28.00		
Crop Price	6.30			6.30			6.30		
TOTAL CROP REVENUE	248.22			176.40			176.40		
BREAK-EVEN YIELD									
TVC	11.79	-1.41	7.93%	11.59	-2.66	0.36%	16.23	-1.55	6.06%
TC	29.33	-0.91	30.50%	19.73	-1.35	8.85%	25.90	-0.28	38.97%

	D			B			E		
	Min. till 13	St. Dev. 16.3	% Below Break-even	Min. till 34	St. Dev. 7.1	% Below Break-even	Min. till 41	St. Dev. 26	% Below Break-even
SOYBEAN FIELDS MINIMUM TILLAGE	1-88			2-87			2-87		
Cost of Operations (OP)	58.06			35.42			127.39		
Total Material Costs (MA)	67.79			89.81			90.88		
Fuel Costs	0.92			0.76			1.80		
Labour Costs	9.00			0.10			8.70		
TOTAL VARIABLE COST	77.71			70.77			101.38		
TOTAL COSTS (OP + MA)	125.87			105.33			218.27		
Yield	26.00			35.40			44.10		
Crop Price	6.30			6.30			6.30		
TOTAL CROP REVENUE	163.80			223.02			277.83		
BREAK-EVEN YIELD									
TVC	12.33	-0.84	20.05%	11.23	-3.40	0.00%	16.09	-1.08	14.01%
TC	19.98	-0.37	35.57%	16.72	-2.83	0.43%	34.05	-0.39	35.94%

	D			A			C			E		
	No till 14	St. Dev. 12.4	% Below Break-even	No till 29	St. Dev. 10	% Below Break-even	No till 36	St. Dev. 7.3	% Below Break-even	No till 42	St. Dev. 21.4	% Below Break-even
SOYBEAN FIELDS NO TILLAGE	3-86			3-86			3-88			3-87		
Cost of Operations (OP)	134.23			139.57			67.82			111.91		
Total Material Costs (MA)	47.13			48.23			87.80			90.8		
Fuel Costs	2.65			2.88			1.31			1.53		
Labour Costs	15.20			16.30			10.40			7		
TOTAL VARIABLE COST	64.98			66.41			99.31			99.43		
TOTAL COSTS (OP + MA)	181.36			187.80			155.42			202.81		
Yield	52.70			33.10			29.00			35.3		
Crop Price	6.30			6.30			6.30			6.30		
TOTAL CROP REVENUE	332.01			208.53			182.70			222.39		
BREAK-EVEN YIELD												
TVC	10.31	-3.42	0.00%	11.02	-1.16	12.30%	15.76	-1.81	3.51%	15.78	-0.91	18.14%
TC	28.79	-1.93	2.66%	29.81	-0.17	43.25%	24.87	-0.59	27.75%	32.19	-0.15	44.04%

Yield Variability and
BREAKEVEN ANALYSIS WITH DECADE HIGH PRICE
 For Soybean T-2000 Participants, 1986-88
 Using Purchase Price for Machinery
 (Dollars per Acre)

	A		B		C	
	Conv. till 1-88	St. Dev. 19.6	Conv. till 1-87	St. Dev. 8.1	Conv. till 1-88	St. Dev. 7.6
SOYBEAN FIELDS CONVENTIONAL TILLAGE						
Cost of Operations (OP)	136.57		70.10		75.57	
Total Material Costs (MA)	48.23		54.23		87.60	
Fuel Costs	3.55		2.10		1.76	
Labour Costs	22.50		16.70		12.90	
TOTAL VARIABLE COST	74.28		73.03		102.26	
TOTAL COSTS (OP + MA)	184.80		124.33		163.17	
Yield	39.40		28.00		28.00	
Crop Price	9.33		9.33		9.33	
TOTAL CROP REVENUE	367.60		261.24		261.24	
BREAKEVEN YIELD						
TVC	7.96	-1.00	7.83	-3.31	10.96	-2.24
TC	19.81	-1.00	13.33	-2.41	17.49	-1.38

	D		E	
	Min. till 1-86	St. Dev. 16.3	Min. till 2-87	St. Dev. 7.1
SOYBEAN FIELDS MINIMUM TILLAGE				
Cost of Operations (OP)	56.06		127.39	
Total Material Costs (MA)	67.76		90.88	
Fuel Costs	0.92		1.80	
Labour Costs	9.00		8.70	
TOTAL VARIABLE COST	77.71		101.38	
TOTAL COSTS (OP + MA)	125.87		218.27	
Yield	26.00		44.10	
Crop Price	9.33		9.33	
TOTAL CROP REVENUE	242.58		411.45	
BREAKEVEN YIELD				
TVC	8.33	-1.08	7.59	-3.92
TC	13.49	-0.77	11.29	-3.40

	A		B		C	
	No till 3-86	St. Dev. 12.4	No till 3-88	St. Dev. 19	No till 3-88	St. Dev. 7.3
SOYBEAN FIELDS NO TILLAGE						
Cost of Operations (OP)	134.23		139.57		67.82	
Total Material Costs (MA)	47.13		48.23		87.60	
Fuel Costs	2.85		2.88		1.31	
Labour Costs	15.20		18.30		10.40	
TOTAL VARIABLE COST	64.98		69.41		99.31	
TOTAL COSTS (OP + MA)	181.36		187.80		155.42	
Yield	52.70		33.10		29.00	
Crop Price	9.33		9.33		9.33	
TOTAL CROP REVENUE	481.69		308.82		270.57	
BREAKEVEN YIELD						
TVC	8.33	-1.08	7.59	-3.92	10.87	-1.26
TC	13.49	-0.77	11.29	-3.40	23.39	-0.80

	D		E	
	No till 3-86	St. Dev. 12.4	No till 3-87	St. Dev. 21.4
SOYBEAN FIELDS NO TILLAGE				
Cost of Operations (OP)	134.23		111.91	
Total Material Costs (MA)	47.13		90.9	
Fuel Costs	2.85		1.53	
Labour Costs	15.20		7	
TOTAL VARIABLE COST	64.98		99.43	
TOTAL COSTS (OP + MA)	181.36		202.81	
Yield	52.70		35.3	
Crop Price	9.33		9.33	
TOTAL CROP REVENUE	481.69		329.35	
BREAKEVEN YIELD				
TVC	8.33	-1.08	42	-1.11
TC	13.49	-0.77	3-87	-1.11

	A		B		C	
	No till 3-86	St. Dev. 12.4	No till 3-88	St. Dev. 19	No till 3-88	St. Dev. 7.3
SOYBEAN FIELDS NO TILLAGE						
Cost of Operations (OP)	134.23		139.57		67.82	
Total Material Costs (MA)	47.13		48.23		87.60	
Fuel Costs	2.85		2.88		1.31	
Labour Costs	15.20		18.30		10.40	
TOTAL VARIABLE COST	64.98		69.41		99.31	
TOTAL COSTS (OP + MA)	181.36		187.80		155.42	
Yield	52.70		33.10		29.00	
Crop Price	9.33		9.33		9.33	
TOTAL CROP REVENUE	481.69		308.82		270.57	
BREAKEVEN YIELD						
TVC	8.33	-1.08	7.59	-3.92	10.87	-1.26
TC	13.49	-0.77	11.29	-3.40	23.39	-0.80

Corn

Breakeven Analysis with T-2000, Decade High, and Decade Low Prices

**Yield Variability and
BREAK-EVEN ANALYSIS WITH T-2000 PRICE**
For Corn T-2000 Participants, 1986-89
Using Purchase Price for Machinery
(Dollars per Acre)

	A			B			C			D			E		
	Conv. till	1	St. Dev.	% Below	Conv. till	7	St. Dev.	% Below	Conv. till	10	St. Dev.	% Below	Conv. till	27	St. Dev.
CORN FIELDS CONVENTIONAL TILLAGE	1-87	1-86	14.6	Break-even	1-87	1-86	8.4	Break-even	1-87	1-86	8.4	Break-even	1-87	1-86	7.7
Cost of Operations (OP)	93.32	152.35			174.41	156.57			174.41	156.57			90.85	76.6	
Total Material Costs (MA)	103.84	135.56			105.50	66.61			105.50	66.61			0.8	0.8	
Fuel Costs	2.61	0.57			1.06	0.89			1.06	0.89			7	7	
Labour Costs	10.80	6.50			9.00	11.70			9.00	11.70			66.40	81.20	
TOTAL VARIABLE COST	117.25	144.63			115.56	81.20			115.56	81.20			169.45	169.45	
TOTAL COSTS (OP + MA)	197.36	287.91			270.91	225.18			270.91	225.18			112	112	
Yield	87.00	133.30			130.20	89.20			130.20	89.20			3.25	3.25	
Crop Price	3.25	3.25			3.25	3.25			3.25	3.25			364.00	364.00	
TOTAL CROP REVENUE	282.75	433.23			423.15	289.90			423.15	289.90					
BREAK-EVEN YIELD															
TVC	36.08	-3.49	0.07%		44.50	-10.57	0.00%		35.57	-11.27	0.00%		26.58	-11.09	0.00%
TC	60.73	-1.80	3.59%		88.59	-5.32	0.00%		86.13	-5.25	0.00%		52.14	-7.77	0.00%
	A			B			C			E			N		
	Min. till	2	St. Dev.	% Below	Min. till	8	St. Dev.	% Below	Min. till	11	St. Dev.	% Below	Min. till	43	St. Dev.
CORN FIELDS MINIMUM TILLAGE	2-87	2-86	10.3	Break-even	2-87	2-86	14.8	Break-even	2-87	2-86	14.8	Break-even	2-87	2-86	16.3
Cost of Operations (OP)	85.23	119.33			95.34	84.37			95.34	84.37			130.85	101.33	
Total Material Costs (MA)	100.83	135.56			113.82	76.6			113.82	76.6			155	155	
Fuel Costs	2.06	0.40			0.56	1.04			0.56	1.04			10.2	10.2	
Labour Costs	9.20	7.00			5.50	9			5.50	9			113.08	113.08	
TOTAL VARIABLE COST	112.09	142.96			119.68	88.64			119.68	88.64			232.26	232.26	
TOTAL COSTS (OP + MA)	186.06	254.89			208.86	162.07			208.86	162.07			83	83	
Yield	86.00	132.30			111.80	97.8			111.80	97.8			3.25	3.25	
Crop Price	3.25	3.25			3.25	3.25			3.25	3.25			269.75	269.75	
TOTAL CROP REVENUE	279.50	429.98			363.35	317.85			363.35	317.85					
BREAK-EVEN YIELD															
TVC	34.49	-5.00	0.00%		43.99	-5.97	0.00%		36.82	-5.07	0.00%		34.70	-2.06	0.15%
TC	57.25	-2.79	0.26%		78.43	-3.84	0.05%		64.30	-3.21	0.11%		71.47	-0.71	23.88%
	B			C			D			N			O		
	No till	9	St. Dev.	% Below	No till	12	St. Dev.	% Below	No till	14	St. Dev.	% Below	No till	46	St. Dev.
CORN FIELDS NO TILLAGE	3-86	3-87	7.2	Break-even	3-86	3-87	7.2	Break-even	3-86	3-87	7.2	Break-even	3-86	3-87	13.4
Cost of Operations (OP)	92.68	95.44			105.41	119.7			105.41	119.7			108.49	108.49	
Total Material Costs (MA)	135.56	118.12			93.08	101.33			93.08	101.33			101.49	101.49	
Fuel Costs	0.18	0.52			0.73	1.31			0.73	1.31			6.1	6.1	
Labour Costs	5.00	4.50			8.20	6			8.20	6			118.00	118.00	
TOTAL VARIABLE COST	140.74	123.14			102.01	111.64			102.01	111.64			209.98	209.98	
TOTAL COSTS (OP + MA)	228.24	213.56			188.49	221.03			188.49	221.03			91.0	91.0	
Yield	127.50	134.80			105.90	80.1			105.90	80.1			3.25	3.25	
Crop Price	3.25	3.25			3.25	3.25			3.25	3.25			269.66	269.66	
TOTAL CROP REVENUE	414.38	438.10			344.18	260.33			344.18	260.33					
BREAK-EVEN YIELD															
TVC	43.30	-11.69	0.00%		31.36	-10.35	0.00%		34.35	-3.41	0.06%		36.34	-4.15	0.00%
TC	70.23	-7.95	0.00%		61.07	-9.60	0.00%		68.01	-0.90	18.41%		64.61	-2.04	2.07%

CORN FIELDS CONVENTIONAL TILLAGE	F			G			H			I			J		
	Conv. till 60 1-88	St Dev. 19.6	% Below Breakeven	Conv. till 62 1-87	St Dev. 11.1	% Below Breakeven	Conv. till 67 1-86	St Dev. 6.1	% Below Breakeven	Conv. till 69 1-87	St Dev. 13	% Below Breakeven	Conv. till 72 1-88	St Dev. 13	% Below Breakeven
Cost of Operations (OP)	121.47			169.62			151.54			128.68			117.88		
Total Material Costs (MA)	127.82			55.33			109.34			132.74			133.44		
Fuel Costs	2.17			3.34			1.52			1.26			1.34		
Labour Costs	16.3			20.3			13.8			7.8			7.8		
TOTAL VARIABLE COST	146.29			78.97			124.66			141.80			142.58		
TOTAL COSTS (OP + MA)	248.29			221.95			260.88			261.42			251.32		
Yield	109.3			139.4			125.3			176.3			121.6		
Crop Price	3.25			3.25			3.25			3.25			3.25		
TOTAL CROP REVENUE	355.23			453.05			407.23			572.98			395.20		
BREAKEVEN YIELD															
TVC	45.01	-3.28	0.10%	24.30	-10.37	0.00%	38.36	-14.25	0.00%	43.63	-10.21	0.00%	43.87	-9.98	0.00%
TC	76.70	-1.86	4.85%	68.29	-6.41	0.00%	80.27	-7.38	0.00%	80.44	-7.37	0.00%	77.33	-3.41	0.08%
CORN FIELDS MINIMUM TILLAGE	O			G			H			I			J		
	Min. till 45 2-89	St Dev. 16.3	% Below Breakeven	Min. till 63 2-87	St Dev. 17.7	% Below Breakeven	Min. till 68 2-86	St Dev. 7.1	% Below Breakeven	Min. till 70 2-87	St Dev. 7.2	% Below Breakeven	Min. till 71 2-87	St Dev. 7.2	% Below Breakeven
Cost of Operations (OP)	115.24			164.72			167.86			132.34			140.35		
Total Material Costs (MA)	101.49			55.33			109.34			132.74			132.74		
Fuel Costs	5.07			3.24			1.47			1.33			1.32		
Labour Costs	7.3			19.8			14.8			6.1			8.2		
TOTAL VARIABLE COST	114.76			78.37			125.61			143.17			142.26		
TOTAL COSTS (OP + MA)	216.73			220.05			277.20			265.08			273.09		
Yield	94.9			133.3			113.5			161.6			190.6		
Crop Price	3.25			3.25			3.25			3.25			3.25		
TOTAL CROP REVENUE	308.43			433.23			368.88			622.70			619.45		
BREAKEVEN YIELD															
TVC	35.31	-3.69	0.05%	24.11	-6.17	0.00%	38.65	-10.54	0.00%	44.05	-20.49	0.00%	43.77	-20.39	0.00%
TC	66.69	-1.73	4.18%	67.71	-3.71	0.04%	85.29	-3.97	0.01%	81.56	-16.28	0.00%	84.03	-14.80	0.00%
CORN FIELDS NO TILLAGE	F			P			Q			R			K		
	No till 61 3-89	St Dev. 19	% Below Breakeven	No till 76 3-86	St Dev. 12.4	% Below Breakeven	No till 78 3-87	St Dev. 12.4	% Below Breakeven	No till 80 3-88	St Dev. 12.4	% Below Breakeven	No till 82 3-87	St Dev. 7.3	% Below Breakeven
Cost of Operations (OP)	84.3			107.67			76.62			74.29			112.69		
Total Material Costs (MA)	127.82			111.61			97.98			83.26			128.33		
Fuel Costs	0.82			0.62			1.04			0.66			0.39		
Labour Costs	6.1			6.2			6.7			3.6			4.9		
TOTAL VARIABLE COST	134.74			118.43			105.72			87.72			131.62		
TOTAL COSTS (OP + MA)	212.12			219.28			174.60			157.55			239.02		
Yield	140.5			108			114.4			95.4			151		
Crop Price	3.25			3.25			3.25			3.25			3.25		
TOTAL CROP REVENUE	456.63			351.00			371.80			310.05			490.75		
BREAKEVEN YIELD															
TVC	41.46	-5.21	0.00%	36.44	-5.77	0.00%	32.53	-6.60	0.00%	26.99	-5.52	0.00%	40.50	-15.14	0.00%
TC	65.27	-3.96	0.01%	67.47	-3.27	0.10%	53.72	-4.89	0.00%	48.48	-3.78	0.03%	73.54	-10.61	0.00%

CORN FIELDS CONVENTIONAL TILLAGE	K			L			M			Q			R		
	Conv. till	St.Dev.	% Below	Conv. till	St.Dev.	% Below	Conv. till	St.Dev.	% Below	Min. till	St.Dev.	% Below	Min. till	St.Dev.	% Below
	81	1-87	7.6	83	1-89	7.6	103	1-88	12.3	77	2-87	10.8	79	2-88	10.8
			Breakeven			Breakeven			Breakeven			Breakeven			Breakeven
Cost of Operations (OP)	113.84			136.44			126.34			91.52			146.38		
Total Material Costs (MA)	115.34			113.66			78.4			97.98			83.26		
Fuel Costs	0.87			3.25			2.32			1.24			1.68		
Labour Costs	7.2			17			13.7			8.4			5.3		
TOTAL VARIABLE COST	123.41			133.91			94.42			107.62			90.24		
TOTAL COSTS (OP + MA)	229.18			250.10			206.74			189.50			229.84		
Yield	134			141			99.6			117.3			98.2		
Crop Price	3.25			3.25			3.25			3.25			3.25		
TOTAL CROP REVENUE	435.50			458.25			323.70			381.23			319.15		
BREAK-EVEN YIELD															
TVC	37.97	-12.04	0.00%	41.20	-13.13	0.00%	29.05	-5.74	0.00%	33.11	-7.60	0.00%	27.77	-6.52	0.00%
TC	70.52	-8.35	0.00%	76.95	-8.43	0.00%	63.61	-2.93	0.17%	59.31	-5.46	0.00%	70.66	-2.55	0.54%
CORN FIELDS MINIMUM TILLAGE	J			J			P			P			P		
	Min. till	St.Dev.	% Below	Min. till	St.Dev.	% Below	Min. till	St.Dev.	% Below	Min. till	St.Dev.	% Below	Min. till	St.Dev.	% Below
	73	2-88	7.2	74	2-88	7.2	75	2-86	10.8	77	2-87	10.8	79	2-88	10.8
			Breakeven			Breakeven			Breakeven			Breakeven			Breakeven
Cost of Operations (OP)	115.72			114.95			158.69			91.52			146.38		
Total Material Costs (MA)	133.43			133.44			92.59			97.98			83.26		
Fuel Costs	1.22			1.34			1.42			1.24			1.68		
Labour Costs	7.2			9.1			8.2			8.4			5.3		
TOTAL VARIABLE COST	141.85			143.88			102.21			107.62			90.24		
TOTAL COSTS (OP + MA)	249.15			248.39			251.28			189.50			229.84		
Yield	142.4			134.5			103			117.3			98.2		
Crop Price	3.25			3.25			3.25			3.25			3.25		
TOTAL CROP REVENUE	492.80			437.13			334.75			381.23			319.15		
BREAK-EVEN YIELD															
TVC	43.65	-13.72	0.00%	44.27	-12.53	0.00%	31.45	-6.63	0.00%	33.11	-7.60	0.00%	27.77	-6.52	0.00%
TC	76.66	-8.13	0.00%	76.43	-8.07	0.00%	77.32	-2.38	0.87%	59.31	-5.46	0.00%	70.66	-2.55	0.54%
CORN FIELDS NO TILLAGE	L			S			S			S			S		
	No till	St.Dev.	% Below	No till	St.Dev.	% Below	No till	St.Dev.	% Below	No till	St.Dev.	% Below	No till	St.Dev.	% Below
	84	3-89	7.3	102	3-89	21.4	102	3-89	21.4	102	3-89	21.4	102	3-89	21.4
			Breakeven			Breakeven			Breakeven			Breakeven			Breakeven
Cost of Operations (OP)	96.52			53.8			53.8			53.8			53.8		
Total Material Costs (MA)	138.22			159.46			159.46			159.46			159.46		
Fuel Costs	1.3			0.47			0.47			0.47			0.47		
Labour Costs	8.4			5.3			5.3			5.3			5.3		
TOTAL VARIABLE COST	147.02			165.23			165.23			165.23			165.23		
TOTAL COSTS (OP + MA)	234.74			213.26			213.26			213.26			213.26		
Yield	130.1			93.9			93.9			93.9			93.9		
Crop Price	3.25			3.25			3.25			3.25			3.25		
TOTAL CROP REVENUE	422.83			305.18			305.18			305.18			305.18		
BREAK-EVEN YIELD															
TVC	45.51	-11.59	0.00%	50.84	-2.01	2.22%	50.84	-2.01	2.22%	50.84	-2.01	2.22%	50.84	-2.01	2.22%
TC	72.23	-7.93	0.00%	65.92	-1.32	9.34%	65.92	-1.32	9.34%	65.92	-1.32	9.34%	65.92	-1.32	9.34%

[illegible]

Yield Variability and
BREAK-EVEN ANALYSIS WITH DECADE HIGH PRICE
For Corn T-2000 Participants, 1986-89
Using Purchase Prices for Machinery
(Dollars per Acre)

CORN FIELDS CONVENTIONAL TILLAGE	A			B			C			D			E		
	Conv. till 1-87	St Dev. 14.6	% Below Break-even	Conv. till 1-86	St Dev. 8.4	% Below Break-even	Conv. till 1-87	St Dev. 8.4	% Below Break-even	Conv. till 1-86	St Dev. 8.4	% Below Break-even	Conv. till 1-86	St Dev. 8.4	% Below Break-even
Cost of Operations (OP)	93.52			152.35			174.41			156.57			90.85		
Total Material Costs (MA)	103.84			135.56			105.50			68.61			78.5		
Fuel Costs	2.91			0.57			1.06			0.89			0.8		
Labour Costs	10.80			8.50			9.00			11.70			7		
TOTAL VARIABLE COST	117.25			144.63			115.59			81.20			86.40		
TOTAL COSTS (OP + MA)	197.36			287.91			279.91			225.18			169.45		
Yield	87.00			133.30			130.20			89.20			112		
Crop Price	4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	350.61			537.20			524.71			359.48			451.36		
BREAK-EVEN YIELD															
TVC	29.06	-3.97	0.00%	35.89	-11.80	0.00%	28.68	-12.09	0.00%	20.15	-8.22	0.00%	21.44	-11.76	0.00%
TC	48.97	-2.80	0.47%	71.44	-7.36	0.00%	69.46	-7.23	0.00%	55.88	-3.97	0.00%	42.05	-9.08	0.00%
CORN FIELDS MINIMUM TILLAGE	A			B			C			E			N		
	Min. till 2-87	St Dev. 10.3	% Below Break-even	Min. till 2-86	St Dev. 14.8	% Below Break-even	Min. till 2-87	St Dev. 14.8	% Below Break-even	Min. till 2-86	St Dev. 11.09	% Below Break-even	Min. till 2-86	St Dev. 16.3	% Below Break-even
Cost of Operations (OP)	85.23			119.33			95.34			84.37			130.95		
Total Material Costs (MA)	100.83			135.56			113.62			78.6			101.33		
Fuel Costs	2.06			0.40			0.56			1.04			1.55		
Labour Costs	9.20			7.00			5.90			9			10.2		
TOTAL VARIABLE COST	112.09			142.96			119.68			88.64			113.08		
TOTAL COSTS (OP + MA)	186.06			254.89			208.96			162.97			232.28		
Yield	86.00			132.30			111.80			97.8			83		
Crop Price	4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	346.58			533.17			450.55			394.13			334.49		
BREAK-EVEN YIELD															
TVC	27.81	-5.65	0.00%	35.47	-6.54	0.00%	29.70	-5.55	0.00%	22.00	-6.84	0.00%	28.06	-3.37	0.00%
TC	46.17	-3.87	0.00%	63.25	-4.87	0.00%	51.85	-4.95	0.00%	40.44	-5.17	0.00%	57.64	-1.56	5.94%
CORN FIELDS NO TILLAGE	B			C			D			N			O		
	No till 9	St Dev. 7.2	% Below Break-even	No till 3-87	St Dev. 7.2	% Below Break-even	No till 3-88	St Dev. 7.2	% Below Break-even	No till 3-88	St Dev. 13.4	% Below Break-even	No till 46	St Dev. 13.4	% Below Break-even
Cost of Operations (OP)	92.68			95.44			105.41			110.7			108.46		
Total Material Costs (MA)	135.56			118.12			93.08			101.33			101.49		
Fuel Costs	0.18			0.52			0.73			1.31			10.5		
Labour Costs	5.00			4.50			6.20			9			8.1		
TOTAL VARIABLE COST	140.74			123.14			102.01			111.64			118.09		
TOTAL COSTS (OP + MA)	228.24			213.56			198.49			221.03			209.98		
Yield	127.50			134.80			105.90			80.1			91.9		
Crop Price	4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	513.83			543.24			426.78			322.80			370.36		
BREAK-EVEN YIELD															
TVC	34.92	-12.86	0.00%	30.56	-14.48	0.00%	25.31	-11.19	0.00%	27.70	-3.91	0.00%	29.30	-4.67	0.00%
TC	56.84	-9.84	0.00%	52.99	-11.36	0.00%	49.25	-7.87	0.00%	54.85	-1.88	3.01%	52.10	-2.97	0.15%

CORN FIELDS CONVENTIONAL TILLAGE	F			G			H			I			J		
	Conv. till 60 1-89	St. Dev. 19.6	% Below Break-even	Conv. till 62 1-87	St. Dev. 11.1	% Below Break-even	Conv. till 67 1-86	St. Dev. 6.1	% Below Break-even	Conv. till 69 1-87	St. Dev. 13	% Below Break-even	Conv. till 72 1-88	St. Dev. 13	% Below Break-even
Cost of Operations (OP)	121.47			160.62			151.54			128.66			117.88		
Total Material Costs (MA)	127.82			95.33			109.34			132.74			133.44		
Fuel Costs	2.17			3.34			1.52			1.26			1.34		
Labour Costs	16.3			20.3			13.6			7.8			7.8		
TOTAL VARIABLE COST	146.29			76.97			124.96			141.80			142.56		
TOTAL COSTS (OP + MA)	249.29			221.95			260.88			261.42			251.32		
Yield	109.3			139.4			125.3			176.3			121.6		
Crop Price	4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	440.48			561.78			504.96			710.49			490.05		
BREAKEVEN YIELD															
TVC	36.30	-3.72	0.00%	19.60	-10.76	0.00%	30.93	-15.47	0.00%	35.19	-10.85	0.00%	35.38	-6.63	0.00%
TC	61.66	-2.42	0.78%	55.97	-7.60	0.00%	64.73	-9.93	0.00%	64.87	-8.97	0.00%	62.36	-4.56	0.00%
CORN FIELDS MINIMUM TILLAGE	O			G			H			I					
	Min. till 45 2-89	St. Dev. 16.3	% Below Break-even	Min. till 63 2-87	St. Dev. 17.7	% Below Break-even	Min. till 66 2-86	St. Dev. 7.1	% Below Break-even	Min. till 70 2-87	St. Dev. 7.2	% Below Break-even	Min. till 71 2-87	St. Dev. 7.2	% Below Break-even
Cost of Operations (OP)	115.24			164.72			167.86			132.34			140.35		
Total Material Costs (MA)	101.46			55.33			109.34			132.74			132.74		
Fuel Costs	5.97			3.24			1.47			1.33			1.32		
Labour Costs	7.3			16.8			14.8			9.1			8.2		
TOTAL VARIABLE COST	114.76			78.37			125.61			143.17			142.26		
TOTAL COSTS (OP + MA)	216.73			220.05			277.20			265.08			273.09		
Yield	94.9			133.3			113.5			161.6			190.6		
Crop Price	4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	382.45			537.20			457.41			772.19			768.12		
BREAKEVEN YIELD															
TVC	28.48	-4.08	0.00%	19.45	-6.43	0.00%	31.17	-11.60	0.00%	35.53	-21.88	0.00%	35.30	-21.57	0.00%
TC	53.78	-2.52	0.59%	54.90	-4.45	0.00%	66.78	-6.30	0.00%	65.78	-17.48	0.00%	67.78	-17.06	0.00%
CORN FIELDS NO TILLAGE	F			P			Q			R			K		
	No till 61 3-89	St. Dev. 19	% Below Break-even	No till 76 3-88	St. Dev. 12.4	% Below Break-even	No till 78 3-87	St. Dev. 12.4	% Below Break-even	No till 80 3-88	St. Dev. 12.4	% Below Break-even	No till 82 3-87	St. Dev. 7.3	% Below Break-even
Cost of Operations (OP)	84.3			107.67			76.62			74.29			112.69		
Total Material Costs (MA)	127.82			111.61			97.98			83.26			126.33		
Fuel Costs	0.82			0.82			1.04			0.86			0.39		
Labour Costs	6.1			6.2			6.7			3.6			4.9		
TOTAL VARIABLE COST	134.74			118.43			105.72			87.72			131.82		
TOTAL COSTS (OP + MA)	212.12			219.28			174.60			157.55			239.02		
Yield	140.5			108			114.4			95.4			151		
Crop Price	4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	566.22			435.24			461.03			384.46			608.53		
BREAKEVEN YIELD															
TVC	33.43	-5.64	0.00%	29.39	-6.34	0.00%	26.23	-7.11	0.00%	21.77	-5.94	0.00%	32.66	-16.21	0.00%
TC	52.64	-4.62	0.00%	54.41	-4.32	0.00%	43.33	-5.73	0.00%	39.09	-4.54	0.00%	59.31	-12.56	0.00%

CORN FIELDS CONVENTIONAL TILLAGE	K			L			M			Q			P			R		
	Conv. till	St Dev.	% Below	Conv. till	St Dev.	% Below	Conv. till	St Dev.	% Below	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below
	81	7.6	0.00%	83	7.6	0.00%	103	12.3	0.00%	77	10.8	0.00%	75	10.8	0.00%	79	10.8	0.00%
	1-87	1-89	1-89	1-89	1-89	1-89	1-89	1-89	1-89	2-87	2-87	2-87	2-86	2-86	2-86	2-86	2-86	2-86
Cost of Operations (OP)	113.84			136.44			128.34			91.52			158.99			146.38		
Total Material Costs (MA)	115.34			113.66			78.4			97.98			92.59			83.26		
Fuel Costs	0.87			3.25			2.32			1.24			1.42			1.08		
Labour Costs	7.2			17			13.7			8.4			6.2			5.3		
TOTAL VARIABLE COST	123.41			133.91			94.42			107.92			102.21			90.24		
TOTAL COSTS (OP + MA)	229.18			250.10			208.74			189.50			251.28			229.94		
Yield	134			141			99.6			117.3			103			98.2		
Crop Price	4.03			4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	540.02			568.23			401.39			472.72			415.09			395.75		
BREAKEVEN YIELD																		
TVC	30.82	-13.80	0.00%	33.23	-14.18	0.00%	23.43	-6.19	0.00%	26.70	-7.19	0.00%	25.36	-7.19	0.00%	22.30	-7.02	0.00%
TC	56.87	-10.15	0.00%	62.06	-10.39	0.00%	51.30	-9.93	0.00%	47.02	-9.51	0.00%	42.35	-9.51	0.00%	36.06	-9.82	0.00%
CORN FIELDS MINIMUM TILLAGE	J			J			J			J			J			J		
	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below	Min. till	St Dev.	% Below
	73	7.2	0.00%	74	7.2	0.00%	74	7.2	0.00%	74	7.2	0.00%	74	7.2	0.00%	74	7.2	0.00%
	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86	2-86
Cost of Operations (OP)	115.72			114.05			114.05			114.05			114.05			114.05		
Total Material Costs (MA)	133.43			133.44			133.44			133.44			133.44			133.44		
Fuel Costs	1.22			1.34			1.34			1.34			1.34			1.34		
Labour Costs	7.2			9.1			9.1			9.1			9.1			9.1		
TOTAL VARIABLE COST	141.85			143.88			143.88			143.88			143.88			143.88		
TOTAL COSTS (OP + MA)	249.15			249.39			249.39			249.39			249.39			249.39		
Yield	142.4			134.5			134.5			134.5			134.5			134.5		
Crop Price	4.03			4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	573.87			542.04			542.04			542.04			542.04			542.04		
BREAKEVEN YIELD																		
TVC	35.20	-14.89	0.00%	35.70	-13.72	0.00%	35.70	-13.72	0.00%	35.70	-13.72	0.00%	35.70	-13.72	0.00%	35.70	-13.72	0.00%
TC	81.82	-11.10	0.00%	81.64	-10.12	0.00%	81.64	-10.12	0.00%	81.64	-10.12	0.00%	81.64	-10.12	0.00%	81.64	-10.12	0.00%
CORN FIELDS NO TILLAGE	L			S			S			S			S			S		
	No till	St Dev.	% Below	No till	St Dev.	% Below	No till	St Dev.	% Below	No till	St Dev.	% Below	No till	St Dev.	% Below	No till	St Dev.	% Below
	84	7.3	0.00%	102	21.4	0.00%	102	21.4	0.00%	102	21.4	0.00%	102	21.4	0.00%	102	21.4	0.00%
	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89	3-89
Cost of Operations (OP)	96.52			53.8			53.8			53.8			53.8			53.8		
Total Material Costs (MA)	138.22			150.46			150.46			150.46			150.46			150.46		
Fuel Costs	1.3			0.47			0.47			0.47			0.47			0.47		
Labour Costs	8.4			5.3			5.3			5.3			5.3			5.3		
TOTAL VARIABLE COST	147.92			165.23			165.23			165.23			165.23			165.23		
TOTAL COSTS (OP + MA)	234.74			213.26			213.26			213.26			213.26			213.26		
Yield	130.1			93.9			93.9			93.9			93.9			93.9		
Crop Price	4.03			4.03			4.03			4.03			4.03			4.03		
TOTAL CROP REVENUE	524.30			378.42			378.42			378.42			378.42			378.42		
BREAKEVEN YIELD																		
TVC	36.70	-12.79	0.00%	41.00	-2.47	0.88%	41.00	-2.47	0.88%	41.00	-2.47	0.88%	41.00	-2.47	0.88%	41.00	-2.47	0.88%
TC	58.25	-9.84	0.00%	52.92	-1.92	2.74%	52.92	-1.92	2.74%	52.92	-1.92	2.74%	52.92	-1.92	2.74%	52.92	-1.92	2.74%

**CORN FIELDS:
CONVENTIONAL
TILLAGE**

Cost of Operations (OP)	
Total Material Costs (MA)	
Fuel Costs	
Labour Costs	
TOTAL VARIABLE COST	
TOTAL COSTS (OP + MA)	
Yield	
Crop Price	
TOTAL CROP REVENUE	
BREAKEVEN YIELD	
TVC	
TC	

CORN FIELDS MINIMUM TILLAGE	S		M		M	
	Min. till	St.Dev.	Min. till	St.Dev.	Min. till	St.Dev.
	101	% Below	104	% Below	105	% Below
	2-86	Breakeven	2-86	Breakeven	2-86	Breakeven
Cost of Operations (OP)	55.89		120.17		138.0	
Total Material Costs (MA)	139.46		78.4		78.4	
Fuel Costs	0.46		1.82		2.89	
Labour Costs	6.7		10.9		15.2	
TOTAL VARIABLE COST	166.64		91.12		96.19	
TOTAL COSTS (OP + MA)	215.35		196.57		217.30	
Yield	85		109		102.7	
Crop Price	4.03		4.03		4.03	
TOTAL CROP REVENUE	342.95		427.16		413.88	
BREAKEVEN YIELD	Z		Z		Z	
TVC	41.35	-1.96	22.61	-5.83	23.87	-5.51
C	53.44	-1.21	49.27	-3.97	53.92	-3.41
						</

**CORN FIELDS
NO TILLAGE**

Cost of Operations (OP)	
Total Material Costs (MA)	
Fuel Costs	
Labour Costs	
TOTAL VARIABLE COST	
TOTAL COSTS (OP + MA)	
Yield	
Crop Price	
TOTAL CROP REVENUE	
BREAKEVEN YIELD	
TVC	
TC	

**Yield Variability and
BREAK-EVEN ANALYSIS WITH DECADE LOW PRICE
For Corn T-2000 Participants, 1986-88
Using Purchase Price for Machinery
(Dollars per Acre)**

CORN FIELDS CONVENTIONAL TILLAGE	A			B			C			D			E		
	Conv. till 1-87	St.Dev. 14.6	% Below Break-even	Conv. till 1-86	St.Dev. 8.4	% Below Break-even	Conv. till 1-87	St.Dev. 8.4	% Below Break-even	Conv. till 1-88	St.Dev. 8.4	% Below Break-even	Conv. till 1-88	St.Dev. 7.7	% Below Break-even
Cost of Operations (OP)	93.52			152.35			174.41			156.57			90.85		
Total Material Costs (MA)	103.84			135.56			105.50			98.61			78.6		
Fuel Costs	2.81			0.37			1.09			0.89			0.8		
Labour Costs	10.80			8.50			9.00			11.70			7		
TOTAL VARIABLE COST	117.25			144.83			115.59			81.20			88.40		
TOTAL COSTS (OP + MA)	197.36			287.91			279.91			225.18			196.45		
Yield	87.00			133.30			130.20			89.20			112		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	198.36			303.92			296.88			203.38			255.36		
BREAK-EVEN YIELD															
TVC	51.43	-2.44	0.73%	63.43	-8.32	0.00%	50.70	-9.48	0.00%	35.61	-9.38	0.00%	37.89	-9.62	0.00%
TC	86.56	-0.03	48.80%	126.28	-0.84	20.05%	122.77	-0.88	18.94%	98.76	1.14	87.29%	74.32	-4.89	0.00%
CORN FIELDS MINIMUM TILLAGE	A			B			C			E			N		
	Min. till 2-87	St.Dev. 10.3	% Below Break-even	Min. till 2-86	St.Dev. 14.8	% Below Break-even	Min. till 2-87	St.Dev. 14.8	% Below Break-even	Min. till 2-86	St.Dev. 11.06	% Below Break-even	Min. till 2-88	St.Dev. 16.3	% Below Break-even
Cost of Operations (OP)	85.23			119.33			95.34			84.37			130.95		
Total Material Costs (MA)	109.83			135.56			113.62			78.6			101.33		
Fuel Costs	2.06			0.40			0.56			1.04			1.35		
Labour Costs	9.20			7.00			5.50			9			10.2		
TOTAL VARIABLE COST	112.09			142.96			119.88			88.64			113.08		
TOTAL COSTS (OP + MA)	186.06			254.80			208.96			162.97			232.28		
Yield	86.00			132.30			111.80			97.8			83		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	196.08			301.64			254.90			222.98			189.24		
BREAK-EVEN YIELD															
TVC	46.16	-3.58	0.00%	62.70	-4.70	0.00%	52.49	-4.01	0.00%	38.88	-5.31	0.00%	49.60	-2.05	2.02%
TC	81.61	-0.43	33.36%	111.79	-1.39	8.23%	91.65	-1.36	8.66%	71.46	-2.37	0.89%	101.88	1.19	87.70%
CORN FIELDS NO TILLAGE	B			C			D			N			O		
	No till 3-88	St.Dev. 7.2	% Below Break-even	No till 3-87	St.Dev. 7.2	% Below Break-even	No till 3-88	St.Dev. 7.2	% Below Break-even	No till 3-88	St.Dev. 13.4	% Below Break-even	No till 3-88	St.Dev. 13.4	% Below Break-even
Cost of Operations (OP)	92.68			95.44			105.41			119.7			108.49		
Total Material Costs (MA)	135.56			118.12			93.08			101.33			101.46		
Fuel Costs	0.18			0.52			0.73			1.31			10.5		
Labour Costs	5.00			4.50			8.20			9			6.1		
TOTAL VARIABLE COST	140.74			123.14			102.01			111.64			118.09		
TOTAL COSTS (OP + MA)	228.34			213.56			188.49			221.03			208.06		
Yield	127.50			134.80			105.90			80.1			91.9		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	290.70			307.34			241.45			182.63			206.53		
BREAK-EVEN YIELD															
TVC	61.73	-8.13	0.00%	54.01	-11.22	0.00%	44.74	-8.46	0.00%	48.98	-2.32	1.02%	51.79	-2.96	0.14%
TC	100.11	-3.80	0.00%	93.97	-5.71	0.00%	87.08	-2.82	0.44%	96.94	1.28	89.62%	82.10	0.01	50.40%

CORN FIELDS CONVENTIONAL TILLAGE	F			G			H			I			J		
	Conv. till	St. Dev.	% Below	Conv. till	St. Dev.	% Below	Conv. till	St. Dev.	% Below	Conv. till	St. Dev.	% Below	Conv. till	St. Dev.	% Below
	60	19.6	1.07%	62	11.1	0.00%	67	6.1	0.00%	69	0.00%	0.00%	72	13	0.00%
	1-89	1-87	1-87	1-87	1-87	1-87	1-87	1-87	1-87	1-87	1-87	1-87	1-88	1-88	1-88
Cost of Operations (OP)	121.47			106.62			151.54			128.68			117.88		
Total Material Costs (MA)	127.82			95.33			109.34			132.74			133.44		
Fuel Costs	2.17			3.24			1.52			1.26			1.34		
Labour Costs	16.3			20.3			13.8			7.8			7.8		
TOTAL VARIABLE COST	146.29			78.97			124.66			141.60			142.58		
TOTAL COSTS (OP + MA)	249.29			221.95			260.86			251.42			251.32		
Yield	100.3			139.4			125.3			176.3			121.6		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	249.20			317.83			285.68			401.96			277.25		
BREAKEVEN YIELD															
TVC	64.16	-2.30	1.07%	34.64	-9.44	0.00%	54.68	-11.56	0.00%	62.19	-8.78	0.00%	62.54	-4.54	0.00%
TC	109.34	0.00	50.00%	97.35	-3.79	0.00%	114.42	-1.78	3.75%	114.66	-4.74	0.00%	110.23	-0.87	19.22%
CORN FIELDS MINIMUM TILLAGE	O			G			H			I			I		
	Min. till	St. Dev.	% Below	Min. till	St. Dev.	% Below	Min. till	St. Dev.	% Below	Min. till	St. Dev.	% Below	Min. till	St. Dev.	% Below
	45	19.3	0.00%	63	17.7	0.00%	68	7.1	0.00%	70	7.2	0.00%	71	7.2	0.00%
	2-89	2-89	2-89	2-87	2-87	2-87	2-86	2-86	2-86	2-87	2-87	2-87	2-87	2-87	2-87
Cost of Operations (OP)	118.24			164.72			167.80			132.34			140.35		
Total Material Costs (MA)	101.49			95.33			109.34			132.74			132.74		
Fuel Costs	5.97			3.24			1.47			1.33			1.32		
Labour Costs	7.3			19.8			14.8			6.1			8.2		
TOTAL VARIABLE COST	114.76			78.37			125.81			143.17			142.29		
TOTAL COSTS (OP + MA)	216.73			220.05			277.20			285.08			273.08		
Yield	94.9			133.3			113.5			191.6			190.6		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	216.37			303.92			256.78			436.85			434.57		
BREAKEVEN YIELD															
TVC	50.33	-2.73	0.32%	34.37	-5.59	0.00%	55.09	-8.23	0.00%	62.79	-17.89	0.00%	62.39	-17.81	0.00%
TC	95.08	0.01	50.40%	96.51	-2.08	1.68%	121.58	1.14	87.29%	119.29	-19.46	0.00%	119.78	-9.84	0.00%
CORN FIELDS NO TILLAGE	F			P			Q			R			K		
	No till	St. Dev.	% Below	No till	St. Dev.	% Below	No till	St. Dev.	% Below	No till	St. Dev.	% Below	No till	St. Dev.	% Below
	81	19	0.00%	78	12.4	0.00%	78	12.4	0.00%	80	12.4	0.00%	82	7.3	0.00%
	3-89	3-89	3-89	3-86	3-86	3-86	3-87	3-87	3-87	3-88	3-88	3-88	3-87	3-87	3-87
Cost of Operations (OP)	84.3			107.67			79.62			74.29			112.60		
Total Material Costs (MA)	127.82			111.61			97.96			83.26			126.33		
Fuel Costs	0.82			0.62			1.04			0.86			0.39		
Labour Costs	6.1			6.2			6.7			3.6			4.9		
TOTAL VARIABLE COST	134.74			118.43			105.72			87.72			131.92		
TOTAL COSTS (OP + MA)	212.12			219.28			174.60			157.55			239.92		
Yield	140.5			108			114.4			95.4			151		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	320.34			246.24			260.83			217.51			344.28		
BREAKEVEN YIELD															
TVC	50.10	-4.28	0.00%	51.94	-4.52	0.00%	46.37	-5.49	0.00%	38.47	-4.59	0.00%	57.73	-12.78	0.00%
TC	93.04	-2.50	0.62%	96.16	-0.85	17.11%	78.58	-3.05	0.11%	69.10	-2.12	1.70%	104.83	-9.32	0.00%

CORN FIELDS CONVENTIONAL TILLAGE	K			L			M			Q			R		
	Conv. till 81	St Dev. 1-87	% Below Breakeven	Conv. till 83	St Dev. 1-89	% Below Breakeven	Conv. till 103	St Dev. 1-88	% Below Breakeven	Min. till 77	St Dev. 2-87	% Below Breakeven	Min. till 76	St Dev. 2-88	% Below Breakeven
Cost of Operations (OP)	113.84			138.44			128.34			91.32			148.38		
Total Material Costs (MA)	115.34			113.66			78.4			97.98			83.28		
Fuel Costs	0.87			3.25			2.32			1.24			1.58		
Labour Costs	7.2			17			13.7			8.4			5.3		
TOTAL VARIABLE COST	123.41			133.91			94.42			107.92			90.24		
TOTAL COSTS (OP + MA)	229.18			250.10			206.74			189.50			229.84		
Yield	134			141			99.6			117.3			88.2		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	305.52			321.48			227.09			267.44			223.90		
BREAK-EVEN YIELD															
TVC	54.13	-10.51	0.00%	58.73	-10.82	0.00%	41.41	-4.73	0.00%	47.20	-6.49	0.00%	39.58	-5.43	0.00%
TC	100.52	-4.41	0.00%	109.69	-4.12	0.00%	90.68	-0.73	23.27%	83.11	-3.17	0.00%	100.72	0.23	58.10%
CORN FIELDS MINIMUM TILLAGE	J			J			P			Q			R		
	Min. till 73	St Dev. 2-88	% Below Breakeven	Min. till 74	St Dev. 2-88	% Below Breakeven	Min. till 75	St Dev. 2-88	% Below Breakeven	Min. till 77	St Dev. 2-87	% Below Breakeven	Min. till 76	St Dev. 2-88	% Below Breakeven
Cost of Operations (OP)	115.72			114.95			158.09			91.32			148.38		
Total Material Costs (MA)	133.43			133.44			92.59			97.98			83.28		
Fuel Costs	1.22			1.34			1.42			1.24			1.58		
Labour Costs	7.2			9.1			8.2			8.4			5.3		
TOTAL VARIABLE COST	141.85			143.86			102.21			107.92			90.24		
TOTAL COSTS (OP + MA)	249.15			248.39			251.28			189.50			229.84		
Yield	142.4			134.5			103			117.3			88.2		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	324.67			306.66			234.84			267.44			223.90		
BREAK-EVEN YIELD															
TVC	82.21	-11.14	0.00%	83.11	-9.92	0.00%	44.83	-5.39	0.00%	47.20	-6.49	0.00%	39.58	-5.43	0.00%
TC	109.25	-4.60	0.00%	108.94	-3.55	0.00%	110.21	0.67	74.88%	83.11	-3.17	0.00%	100.72	0.23	58.10%
CORN FIELDS NO TILLAGE	L			S			S			S			S		
	No till 84	St Dev. 3-89	% Below Breakeven	No till 102	St Dev. 3-89	% Below Breakeven	No till 102	St Dev. 3-89	% Below Breakeven	No till 102	St Dev. 3-89	% Below Breakeven	No till 102	St Dev. 3-89	% Below Breakeven
Cost of Operations (OP)	96.52			53.8			53.8			53.8			53.8		
Total Material Costs (MA)	138.22			159.46			159.46			159.46			159.46		
Fuel Costs	1.3			0.47			0.47			0.47			0.47		
Labour Costs	8.4			5.3			5.3			5.3			5.3		
TOTAL VARIABLE COST	147.92			165.23			165.23			165.23			165.23		
TOTAL COSTS (OP + MA)	234.74			213.26			213.26			213.26			213.26		
Yield	130.1			93.9			93.9			93.9			93.9		
Crop Price	2.28			2.28			2.28			2.28			2.28		
TOTAL CROP REVENUE	298.63			214.09			214.09			214.09			214.09		
BREAK-EVEN YIELD															
TVC	64.88	-8.93	0.00%	72.47	-1.00	15.87%	72.47	-1.00	15.87%	72.47	-1.00	15.87%	72.47	-1.00	15.87%
TC	102.68	-3.72	0.00%	93.54	-0.02	49.20%	93.54	-0.02	49.20%	93.54	-0.02	49.20%	93.54	-0.02	49.20%

CORN FIELDS CONVENTIONAL TILLAGE	S	% Below Break-even	M	% Below Break-even	M	% Below Break-even
	Min. till 101 2-86	St.Dev. 26	Min. till 104 2-86	St.Dev. 14.3	Min. till 105 2-86	St.Dev. 14.3
Cost of Operations (OP)	55.89		120.17		138.9	
Total Material Costs (MA)	159.46		78.4		78.4	
Fuel Costs	0.48		1.82		2.59	
Labour Costs	6.7		10.9		15.2	
TOTAL VARIABLE COST	166.64		91.12		96.19	
TOTAL COSTS (OP + MA)	215.35		198.57		217.30	
Yield	85		108		102.7	
Crop Price	2.28		2.28		2.28	
TOTAL CROP REVENUE	193.80		241.58		234.16	
BREAKEVEN YIELD		Z		Z		Z
TVC	-0.46	32.28%	39.98	-4.62	42.19	-4.23
TC	0.36	84.06%	87.09	-1.32	95.31	-0.82
						30.15%
CORN FIELDS NO TILLAGE						
Cost of Operations (OP)						
Total Material Costs (MA)						
Fuel Costs						
Labour Costs						
TOTAL VARIABLE COST						
TOTAL COSTS (OP + MA)						
Yield						
Crop Price						
TOTAL CROP REVENUE						
BREAKEVEN YIELD						
TVC						
TC						

APPENDIX B

Evaluation of Aeration Tillage Systems Summary of Problems

A summary of the problems and inconsistencies encountered in the data set are presented as follows:

Co-operator: M. Klynstra
field #1

(1989)

- Area sheet of plots matches map - both are broken into 6 plots differentiated by seeding rates, plowing operations, and kelp and molasses treatment - but yields are broken down into 8 plots. O.B.A.T.A. yield plot descriptions do not match the area plot descriptions.

(1990)

- Map states all plots are O.B.A.T.A.; area sheet defines some as standard; yield sheet does not differentiate between plots at all (one yield for the whole field).
- It is not well documented what the crop rotation is each year on individual plots.
- Operations on the growing season calendar do not always match what is documented on the operations and machinery table.

(1991)

- Map information is written over top of 1990 crop map with very little information provided - not sure what is grown in each plot.
- Standard plot appears to be an O.B.A.T.A. plot.
- Growing season calendar says that the standard plot was not foliar sprayed but the operations and machinery table says it was.
- No components listed for foliar spray.

field #2

(1989)

- Yields are not provided for most O.B.A.T.A. plots.
- Components of the foliar spray are not listed.

(1990)

- Hectares and crop descriptions on map do not match the hectares and descriptions on the area sheet, and the yield sheet is a little different from both also.
- Inconsistencies between growing season calendar and operations and machinery (O&M) sheet. Eg. O&M sheet states standard plot was foliar sprayed, calendar says it was not.
- One of the operations on the standard plot is called "tillage" - no specifics are given.
- Principal and Cover Crops sheet lists oats as the only cover crop compared to the four other cover crops listed on the other sheets.

(1991)

- Price of fertilizer not given.
- Components of foliar spray not listed.

Co-operator: A. Pasztor

field #1

(1989)

- Map and area sheet do not agree on standard plot area.
- Operations and machinery sheet has no data for 1989.
- Growing season calendar defines 3 plots, other two sources only define 2 plots.
- Cost of fertilizer not given.

(1990)

- Inconsistent information between the O&M sheet and the calendar sheet. Eg. O&M sheet says both plots were soil saved, calendar says only the Standard plot was, and calendar says O.B.A.T.A. plot was foliar sprayed, O&M sheet does not.
- Cost of fertilizer not given.

(1991)

- Field was not active in the program in 1991.

field #2

(1989)

- Two sources of yield data.
- Operations and machinery sheet has no data for 1989.
- Calendar sheets missing - so no source of information on operations.

(1990)

- No yield data.
- No operations and machinery data
- Calendar sheets missing

(1991)

- Field was not active in the program in 1991.

field #3

(1989)

- Field was not active in the program in 1991.

(1990)

- No yield data.
- No difference between Standard and O.B.A.T.A. crops in operations documented.

(1991)

- Inconsistencies between growing season calendar and operations and machinery sheet. Eg. calendar says fertilizer applied in spring, O&M sheet does not.

Co-operator: J. Van Dorp

field #1

(1989)

- No standard or conventional plot.
- Yield sheet breaks down yield according to differences in fertilizer rates

and not by O.B.A.T.A. plot definitions.

(1990)

- No standard or conventional plot.
- 3 plots defined, but only 2 yields given (differentiated by operations instead of cover-crop).
- Cost of cover crops not given.

(1991)

- No standard or conventional plot.
- Area was reduced from previous years - no consistency for comparison from year to year.

field #2

(1989)

- No standard or conventional plot.
- 4 plots were defined on the map and area sheet, but yields were only given for 3, one of which was defined differently from the map and area sheet.
- Operations on the growing season calendar do not match the operations on the O&M sheet.
- Cost of fertilizer not given.

(1990)

- No standard or conventional plot.
- Yield plot definitions do not match the area sheet or map plot definitions.
- Focus was on Nitrogen test plots, but data was not given to make comparisons.

(1991)

- No map provided - statement made that no formal O.B.A.T.A. treatments were done on this field in 1991 but area data is provided based on 1989 cover crops and yield data is provided on 1990 cover crops.
- No standard or conventional plot.

Co-operator: J. House

field #1

(1989)

- One yield observation is provided for all three O.B.A.T.A. plots (no differentiation between the plots).
- Operations on O&M sheet are not consistent with operations on the growing season calendar.
- Seems to be confusion between 1989 and 1990 data.
- Not stated what fertilizer was used in the foliar spray or in the separate application listed on the calendar.

(1990)

- Area sheet lists different cover crops than the yield sheet. Yields are given based on 1989 cover crops, which is fine except the plots are not consistent according to the maps.
- Inconsistencies between O&M sheet operations and growing season calendar operations. Eg. O&M sheet states only Standard plot was sprayed with Pardner in June; calendar states that no plots received herbicide treatment in June/July.

(1991)

- The crop is corn/soy strips and there is one standard plot and 2 O.B.A.T.A. plots listed (differentiated by foliar spray treatment), but only one corn yield is given for the two O.B.A.T.A. plots.
- Inconsistencies exist between the calendar and the O&M sheet. Eg. O&M states that all plots received NH_3 in June; calendar has no record of any application for any plot.

field #2

(1989)

- 2 O.B.A.T.A. plots defined but only one yield provided.
- Inconsistencies between the calendar and the O&M sheet. Eg. Calendar says Standard plot was fertilized in April/May; O&M sheet does not.
- Components of the foliar spray are not given.

(1990)

- Inconsistencies between the O&M sheet and the growing season calendar.
- Cost of fertilizer in foliar spray not given